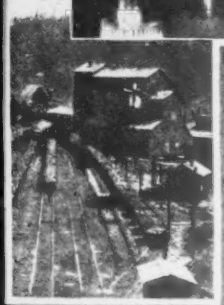
The MINING CONGRESS JOURNAL

Volume 14 SEPTEMBER, 1928 *No.* 9



ANNUAL METALS EDITION

Annual Meeting of Western Division
Improved Marketing Facilities for Copper
Marketing of Silver
California's Commercial Non-Metallic Minerals
Developments in Manganese Production

The New Income Tax Law
The American Petroleum Institute
Promotion of Safety at Ray Plant
Can Oil Shale Be Mined By Stripping Methods?

Underground Ventilation at Copper Queen Mines
Revision of Coarse and Fine Crushing Department, Hurley Plants
The North Lily Shaft at Eureka
The Supply Department
The Mine Manager's Cost Control Problem
Cooperative Mining Development
Diesel Engines As a Source of Power
Preparation and Modification of Ore Pulps for Flotation Grinding

Recent Tendencies in Coal Mine Ventilation
Herringbone Gear Drives on Mine Fans
The Sand Flotation Process As Applied to the Washing of Coal

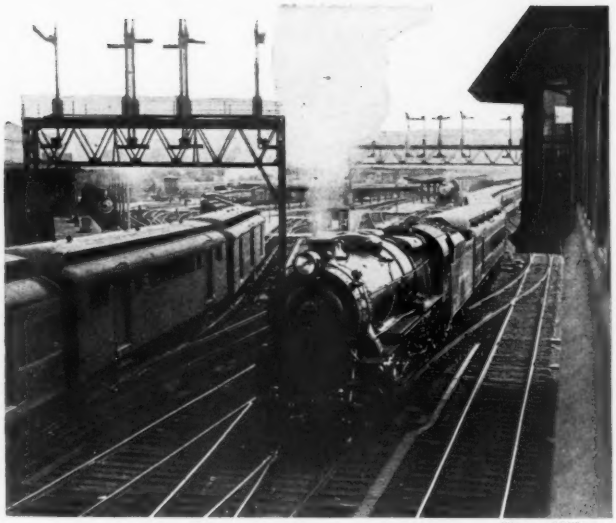
Mechanization Reports
Legislative Review

Contributors:

T. Wolfson, Hamilton M. Brush, Moses Brown, Walter A. Staub, F. E. Cash and M. W. von Bernewitz, Walter W. Bradley, L. M. Fanning, J. Carson Adkerson, J. B. Pullen, J. S. Finlay, Fred Hodges, A. J. MacLean, T. McGrath, James W. Wade, H. H. Pratt, H. S. Martin, Geo. S. Rice, W. H. Lesser, T. M. Chance, G. B. Southward.

JOHN W. SHEERES

No matter how you come,— *COME!*



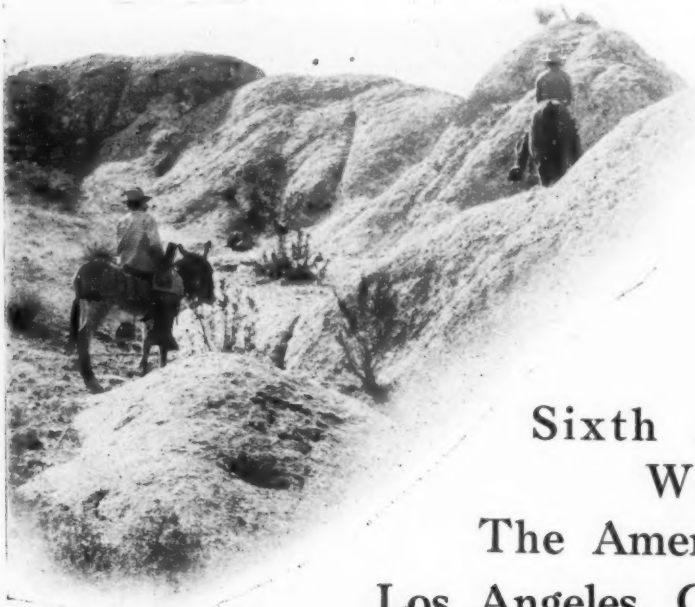
Henry Miller.

COME to the Sixth Annual Meeting of the Western Division of the American Mining Congress which is being held jointly with the Western Chapters of the American Institute of Mining and Metallurgical Engineers and the Mining Section of the California Development Association. The dates are September 10-13. Convention headquarters, Los Angeles Biltmore Hotel, Los Angeles, California.

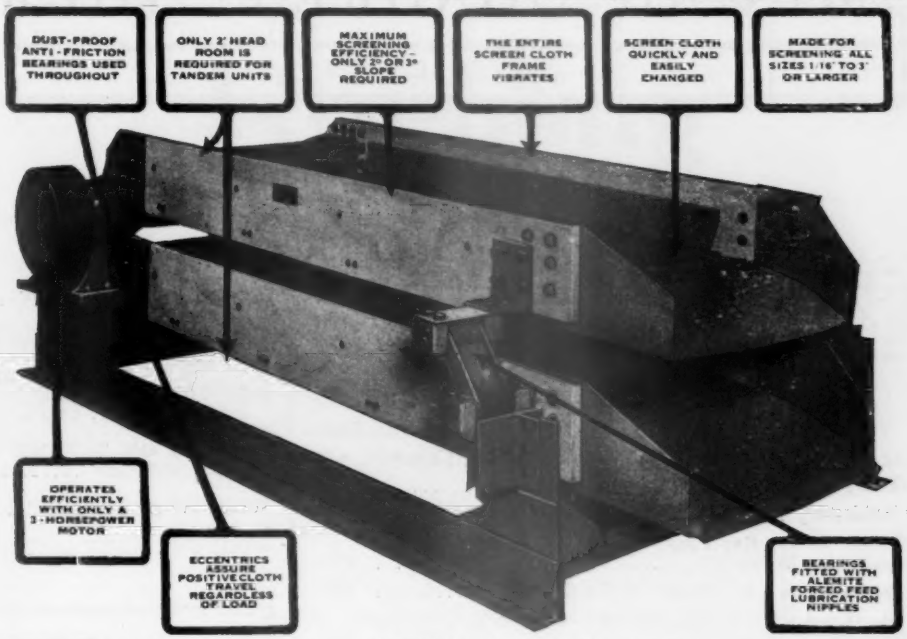
Sessions cover reports of mining progress by districts, technical sessions on mining methods, electrolytic zinc plants, flotation, oil bleaching clays, tripoli, and clay mining methods; practical operating discussions on underground mine ventilation, use of scrapers in underground loading, the supply department, cost control problems, Diesel engines as a source of power. There are to be sessions devoted to mineral development, national publicity on the mining industry, Federal legislation affecting mineral development, and coordination of agencies in mineral research.

The mineral tariff, Federal and State taxation of mines and the need of revision of mining laws to meet the requirements of geophysic prospecting, and stabilization of mine production to prevent the waste of overproduction are problems scheduled for open discussion.

Other subjects in which you are interested are to be discussed in Los Angeles by experienced men whose information will be helpful to you. Entertainment features are provided.



Sixth Annual Convention
Western Division
The American Mining Congress
Los Angeles, Calif., Sept. 10-13, 1928


DUST-PROOF ANTI-FRICTION BEARINGS USED THROUGHOUT
ONLY 2' HEAD ROOM IS REQUIRED FOR TANDEM UNITS
MAXIMUM SCREENING EFFICIENCY—ONLY 2° OR 3° SLOPE REQUIRED
THE ENTIRE SCREEN CLOTH FRAME VIBRATES
SCREEN CLOTH QUICKLY AND EASILY CHANGED
MADE FOR SCREENING ALL SIZES 1 1/4" TO 3" OR LARGER
OPERATES EFFICIENTLY WITH ONLY A 3-HORSEPOWER MOTOR
ECCENTRICS ASSURE POSITIVE CLOTH TRAVEL REGARDLESS OF LOAD
BEARINGS FITTED WITH ALEMITE FORCED FEED LUBRICATION NIPPLES

What You Should Demand

In Vibrating Screens

A prominent engineer in a recent editorial listed the main requisites of an ideal vibrating screen, and although the Arms Vibrating Screen was unknown to him, his recommendations sounded like a review of the features taken from the Arms Screen Bulletin.

So that you may know his recommendations, based on actual operating experience, we illustrate here the Arms Tandem Unit Screen, pointing out these main requisites which are all features of Arms Screens.

Further, the Arms Screen uses no springs, rods, cams, bumpers or other quick wearing parts. Easy to install, it requires no maintenance or attention except occasional lubrication — and screens more per hour at a lower cost.

Arms Screens are made to withstand the most severe punishment; available in sizes 8′ in length, 3′ and 4′ widths, screen mesh 1/16″ to 3″ or larger to suit requirements.

Let us send you a copy of Bulletin No. 87. It tells the story.

R and S Rotary Car-Dumpers are available in sizes and types to suit every condition. Their use assures ultimate efficiency, minimum degradation and low cost dumping. Write for Bulletin No. 103.

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ROTARY CAR DUMPERS
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ARMS CONCENTRATING TABLES AND SCREENS

ENGINEERS AND CONTRACTORS

The MINING CONGRESS JOURNAL

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METALS

Ventilation Problems at Copper Queen Mines
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The Supply Department
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COAL

Recent Tendencies in Coal Mine Ventilation
Herringbone Gear Drives on Mine Fans
Sand Flotation Process as Applied to the Washing of Coal

Published Every Month by The American Mining Congress, Washington, D. C.

Edited under the supervision of James F. Calbreath, Secretary of The American Mining Congress

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"Blue Center" Steel Wire Rope because of its inherent quality, will withstand to the greatest extent sudden shocks, vibration, abrasion and fatigue. For these reasons it is the most economical rope to buy for severe conditions.

A Trial of "Blue Center" on your heavy-duty work will convince you of the truth of this statement. Made in standard sizes and constructions. "Blue Center" is also made in special constructions to fit your particular requirements. Our Engineering Department will gladly advise you as to your needs.

John A. Roebling's Sons Company
Trenton, New Jersey

This Machine Drives Rapidly and

Cuts, Loads and Conveys Without

The Jeffrey
SHORTWALOADER

Loading out coal at the face and discharging into a Jeffrey Sectional Conveyor laid in the entry.

Branch Offices: New York Pittsburgh Scranton, Pa. Philadelphia Chicago Birmingham
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JEFFREY

Entries Economically

Leaving the Face

If you are interested in rapid development work, in driving entries as fast as possible, you will be interested in the Shortwaloader, which under average conditions will advance an entry twenty-four to thirty feet per shift.

With the Shortwaloader you will get in addition to rapid development, a greatly reduced cost for entry driving for the Shortwaloader undercuts the coal, loads it onto its swinging boom and discharges it into cars or whatever mine conveyor is working behind it. This machine loads out its own bug dust while cutting, leaving a cleaner kerf for shooting. It does all this without leaving its working place, and stops cutting and loading only while the coal is being shot.

Two loading bars carrying chains and bits swing above the undercutter bar and shift the coal onto the main conveyor of the machine where it is loaded onto the rear conveyor. This rear conveyor can be swung around so that it continues to discharge into cars or a conveyor, regardless of the position of the machine as it moves across the face. The loading bars will pull down standing coal that has been only lightly shot, saving powder and producing a higher percentage of lump coal.

The controls are similar to those of a Shortwall coal cutter and are grouped together within a small radius for the convenience of the operator.

Let us show you where other mine operators have used the Jeffrey Shortwaloader in systems of concentrated mining.

The Jeffrey Manufacturing Company

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Denver Charleston, W. Va. Salt Lake City Montreal, Canada
Pittsburgh, 600 Second Ave. Scranton, 122 Adams Ave. Terre Haute, Ind., 319 Cherry St.

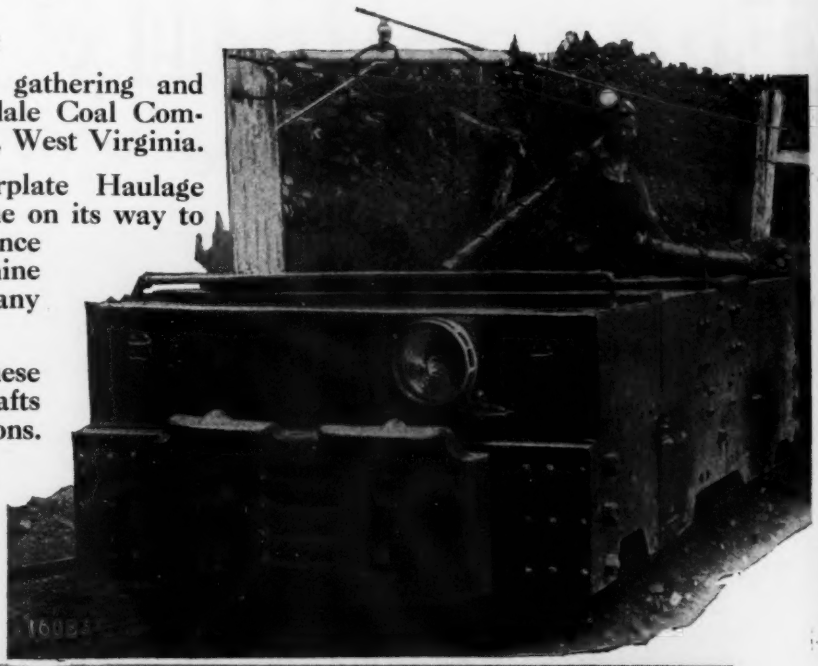
COAL MINE EQUIPMENT

All Jeffrey Locomotives

Amherstdale

Sixteen Jeffrey Locomotives for gathering and hauling are used at the Amherstdale Coal Company's No. 2 Mine at Amherstdale, West Virginia.

This thirteen-ton Jeffrey Armorplate Haulage Locomotive shown outside the mine on its way to the tipple has moved all their coal since it was first put in service over nine years ago. It is still good for many years.



In Jeffrey Locomotives manganese steel is used for the armature shafts and nickel steel for armature pinions. These are heat-treated to give them the proper toughness and hardness. Shafts and pinions shipped for replacement stocks are also of these hard and tough alloy steels.

The Jeffrey Manufacturing Company

958-99 North Fourth St., Columbus, Ohio

Branch Offices: New York Pittsburgh Scranton, Pa. Philadelphia Chicago Birmingham
Sales and Service Stations: Birmingham, 26 South 20th St. Winchester, Ky., 122 N. Main St. Salt Lake City, 153 W. Second South St.

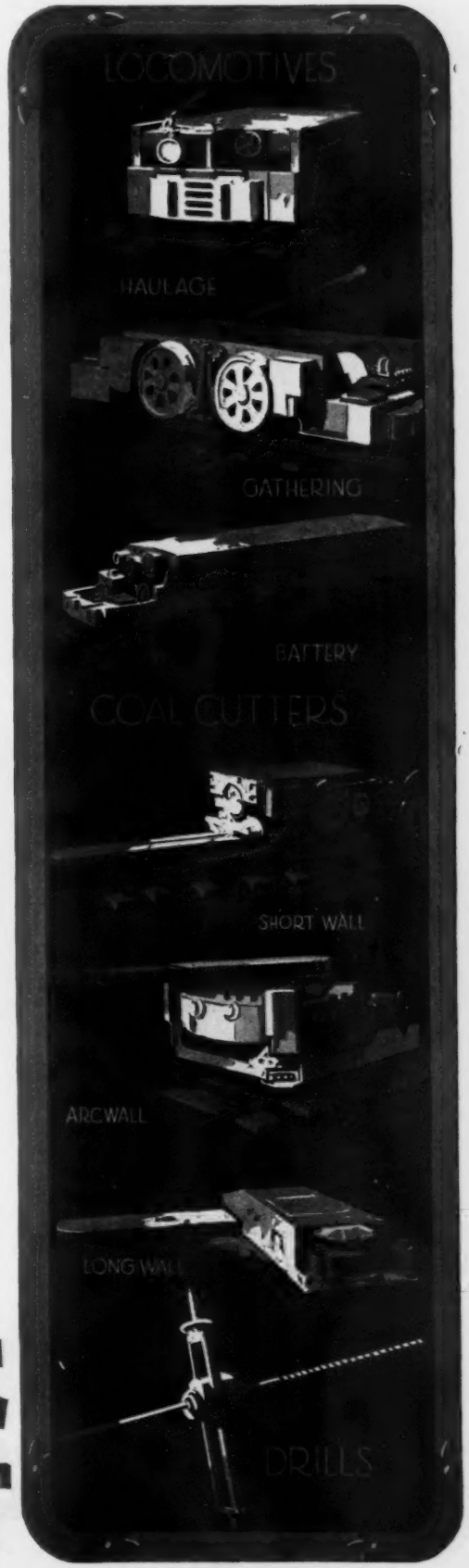
JEFFREY

in These Mines

Island Creek

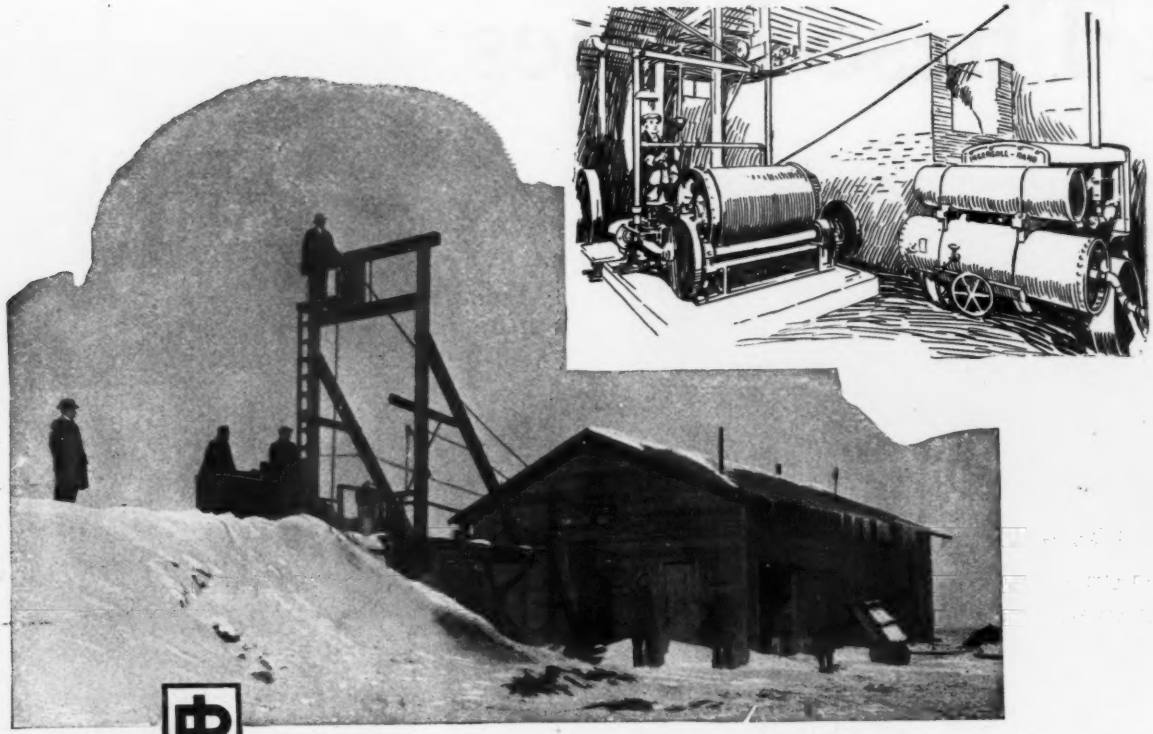
Maintenance on all mining and hauling equipment is less than one-and-one-half cents per ton of coal produced at Mine No. 21 of the Island Creek Coal Company at Holden, West Virginia.

In Mine No. 21 the Island Creek Coal Company operates thirteen Jeffrey Locomotives for both gathering and hauling, five Jeffrey Drills and a Jeffrey Fan. Their other mines increase the number of Jeffrey Locomotives to seventy.



Denver Charleston, W. Va. Salt Lake City Montreal, Canada
Pittsburgh, 600 Second Ave. Scranton, 122 Adams Ave. Terre Haute, Ind., 319 Cherry St.

COAL MINE EQUIPMENT



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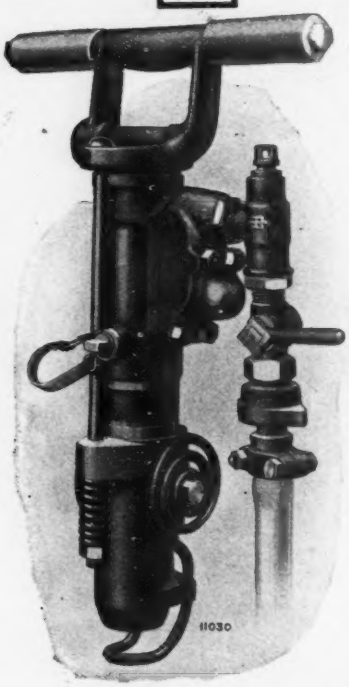

I-R Portable saved the day at the Lindy-Butte Mining Company

During the interval of installing the new steam plant at the Lindy-Butte Mining Company, an Ingersoll-Rand 7 x 6 Portable Compressor was called upon to supply power for the hoisting engine as well as for underground use. In the words of one of the officials of the Company, "the Portable saved the day. Operations continued without interruption until the steam plant was completed."

Working at 6000 ft. altitude, this little 7 x 6 machine was equal to the demands of the hoist which handled 1000 pounds of ore and rock per trip. It also operated three BCR-430 "Jackhamers." During each eight-hour shift, a five foot sink was drilled, blasted, mucked, and a set of timber installed. The gasoline consumption was less than three gallons per hour while the portable was in operation.

The service at this property is typical of Ingersoll-Rand installations in all parts of the world. There is a size and type of compressor, rock drill, or general mining machine to meet any available condition.

The Lindy-Butte Mining Company is located four miles south of Butte, and was so named because ore was struck on the day that Colonel Lindbergh visited Butte on his 22,000 mile trip around the states.

INGERSOLL-RAND COMPANY, 11 Broadway, New York City
Offices in principal cities the world over
For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec

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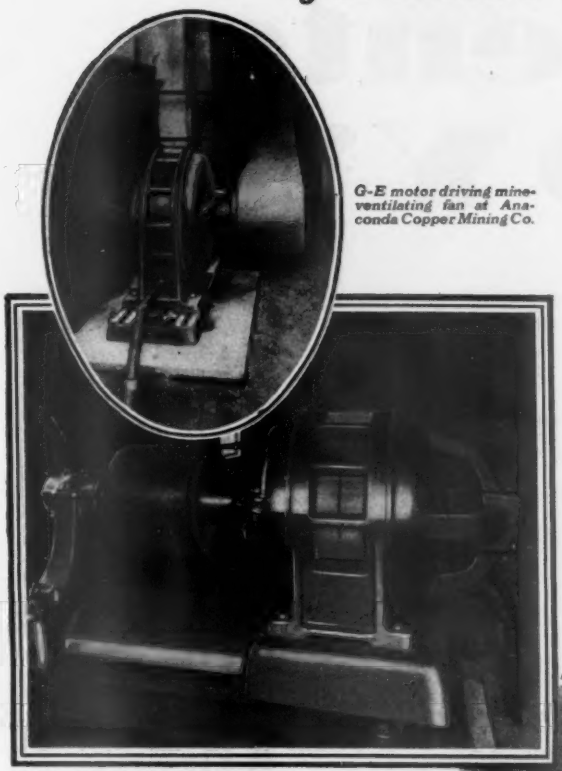
Ingersoll-Rand

Proved Performance
—G-E *motors and control for mine fans*



G-E motor driving mine-ventilating fan at Anaconda Copper Mining Co.

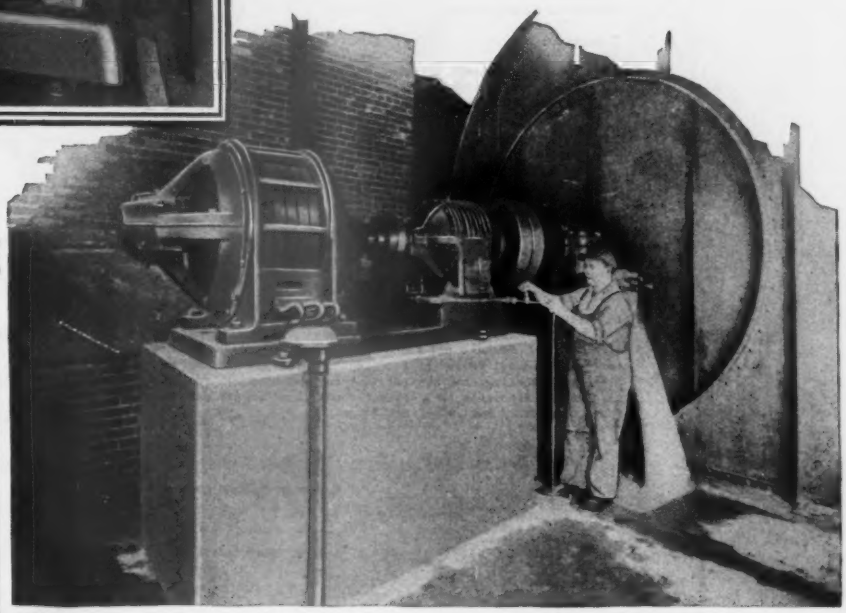
G-E 200-hp. induction motor driving mine-ventilating fan at Philadelphia & Reading Coal & Iron Co., Pottsville, Pa.

Where human life and health depend on reliability—as in mine ventilation—it is vitally important that mine fans be operated by motors and control of proved performance.

G-E motors and control have an unsurpassed reputation for dependability—and for high over-all efficiency as well.

G-E automatic control protects the equipment, thereby helping to insure a continuous supply of healthful air—and it makes possible the starting and stopping of fans from remote points.

Whatever the requirements, General Electric meets them so well that each G-E installation recommends another.



G-E 150-hp. squirrel-cage induction motor driving mine-ventilating fan through speed reducer at Glen Alden Coal Co., Scranton, Pa.

Apply the proper G-E motor and the correct G-E controller to a specific task, following the recommendations of G-E specialists in electric drive, and you have G-E Motorized Power. Built in or otherwise connected to all types of industrial machines, G-E Motorized Power provides lasting assurance that you have purchased the best.

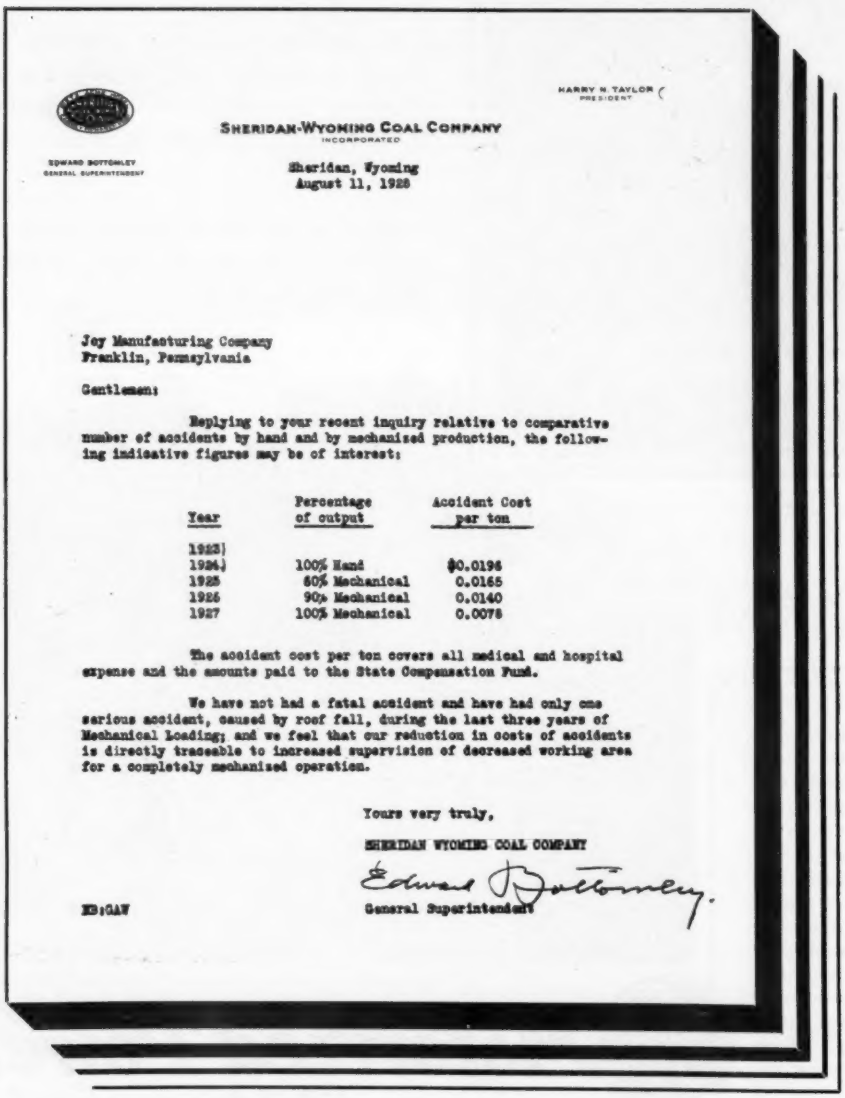
Motorized Power
—fitted to every need

200-170

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

Reduce Accidents with JOY'S



HARRY N. TAYLOR
PRESIDENT

SHERIDAN-WYOMING COAL COMPANY
INCORPORATED

EDWARD BOTTOMLEY
GENERAL SUPERINTENDENT

Sheridan, Wyoming
August 11, 1928

Joy Manufacturing Company
Franklin, Pennsylvania

Gentlemen:

Replying to your recent inquiry relative to comparative number of accidents by hand and by mechanized production, the following indicative figures may be of interest:

Year	Percentage of output	Accident Cost per ton
1923		
1924	100% Hand	$0.0196
1925	60% Mechanical	0.0165
1926	90% Mechanical	0.0140
1927	100% Mechanical	0.0078

The accident cost per ton covers all medical and hospital expense and the amounts paid to the State Compensation Fund.

We have not had a fatal accident and have had only one serious accident, caused by roof fall, during the last three years of Mechanical Loading; and we feel that our reduction in costs of accidents is directly traceable to increased supervision of decreased working area for a completely mechanized operation.

Yours very truly,

SHERIDAN WYOMING COAL COMPANY

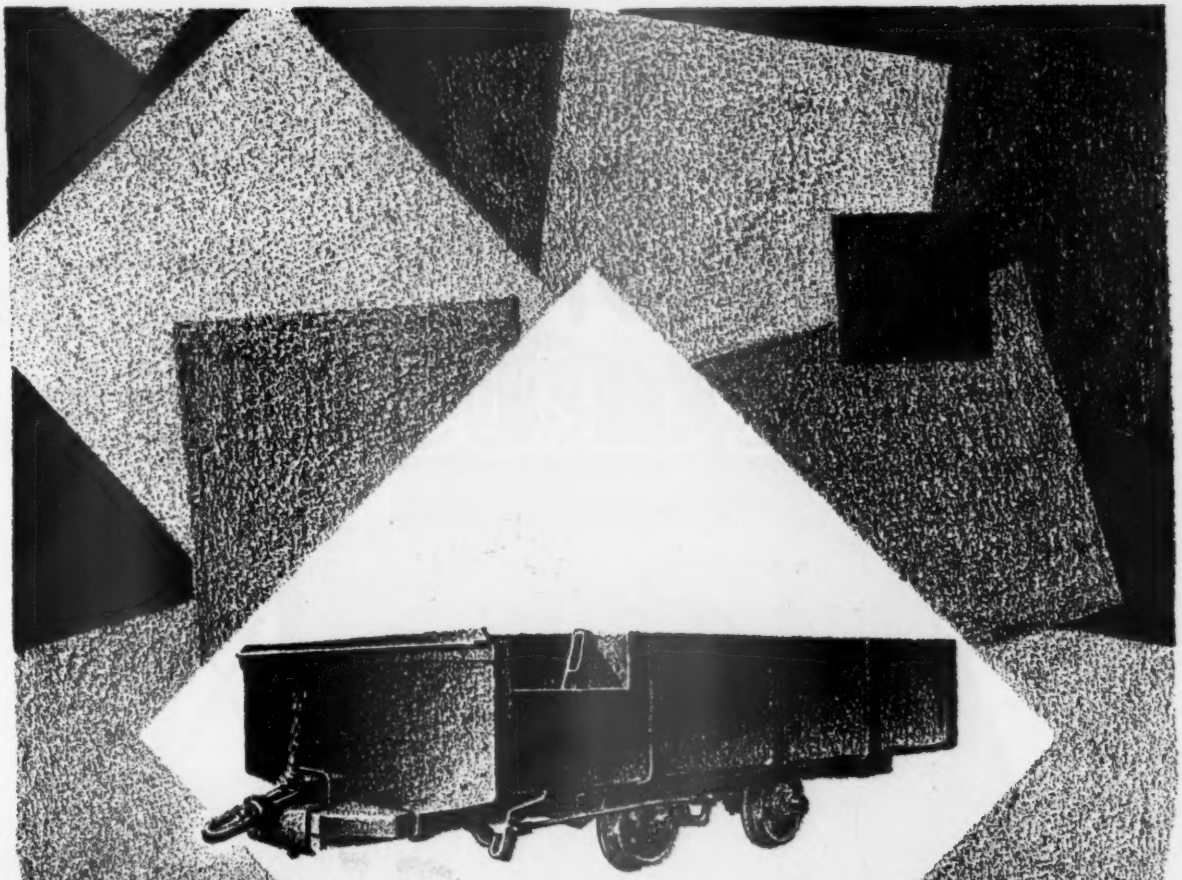
Edward Bottomley.

General Superintendent

EB:GAW

JOY MANUFACTURING CO.

FRANKLIN, PENNA.



COMPETENT

The ability to design cars that meet actual needs—the knowledge to select materials that make cars stand up—the personnel and equipment to construct cars that deliver maximum service at minimum expense—Hockensmith has them all. It's a competent firm that makes competent cars. The next time you're in the market—let Hockensmith quote.

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WHEEL & MINE CAR CO.

Penn, Pa. Long Distance Phone, Jeannette 700

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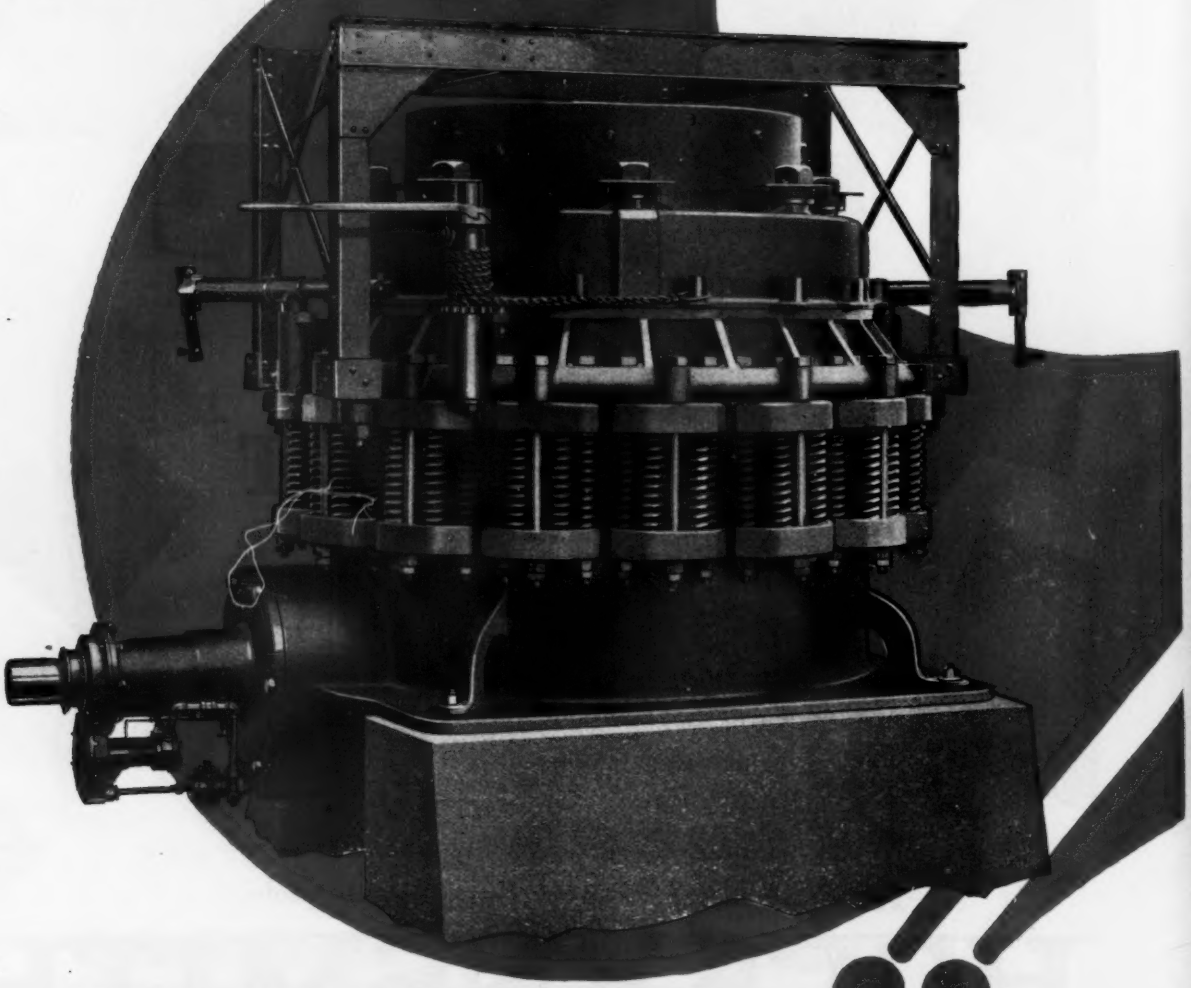
Huntington, W. Va.—Huntington Supply & Equipment Co. **Knoxville, Tenn.—Webster & Co.**
Clarksburg, W. Va.—Mr. Norman Strugnell **Chicago, Ill.—W. W. Baker, 140 So. Dearborn St.**

SYMONS CONE CRUSHERS



IN 5 SIZES

IN THESE days of close competition, when cost of production means so much The SYMONS CONE CRUSHERS are given first consideration. • • •

WHY?——————

They increase production with——— Less Cost and Less Replacement, Installed in Less Time and in Less Space than any other type of crusher.

The CONE in action

SYMONS BROTHERS COMPANY

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CALIF.

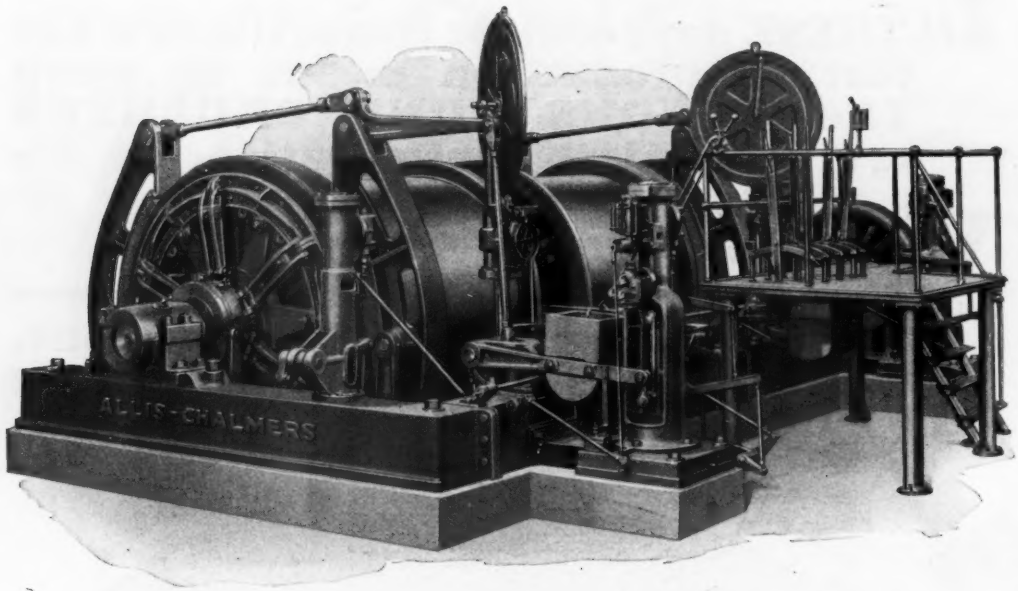
111 W. WASHINGTON ST.
CHICAGO,
ILL.

51 E. 42nd ST.
NEW YORK,
N. Y.

Allis-Chalmers Electric Hoists

At

The Junction Shaft



Calumet and Arizona Mining Co., Arizona

WHERE BIG THINGS ARE BEING DONE, THEREFORE CONTINUITY AND EASE OF OPERATION ARE ESSENTIAL

Note the balanced proportion and pleasing appearance of the entire unit

When considering a new modern hoist investigate carefully:

Type and construction of the clutches.

Type and construction of the brakes.

Design of the auxiliary engines to actuate them.

Safety devices—are they all gear driven?

Your selection of an Allis-Chalmers Hoist will insure obtaining the most modern type and design of every detail.

Let our engineers tell you. *They are at your service.*

ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

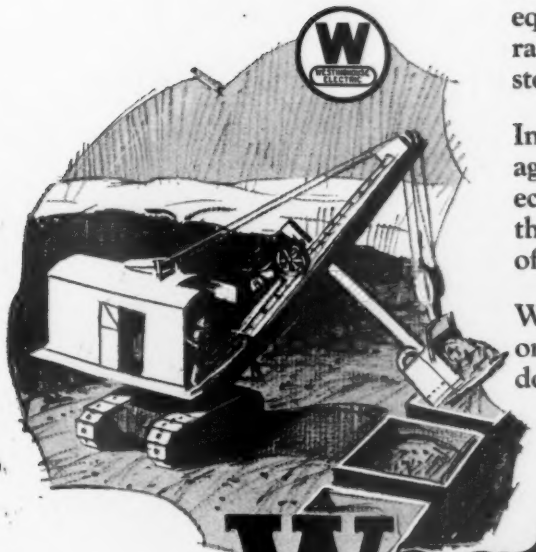
faster digging—

—bigger profits!

MORE bites per working day mean greater income from your shovel equipment. Electric shovels, powered with Westinghouse equipment, have all the flexibility and speed range of steam with no time lost waiting for steam pressure.

In addition to this, Westinghouse variable voltage equipment for power shovels affords greater economy in operation—there's no fuel to handle; there's no fireman required; there's no problem of feed water supply.

With all the advantages of steam plus the economy of electricity, the electric shovel certainly does dig!



Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse

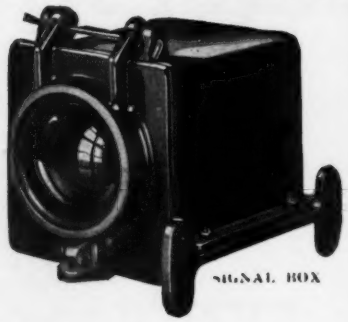
X28748

Variable Voltage Equipment
for Electric Power Shovels

A Flood of Light

IN THE PATHWAY OF A MOTORMAN

Red warns him that some other trip has the right of way. Green, proceed in safety. An Automatic Signal System installed on the haulway will protect trips from collision —permit them to proceed in safety with the least loss of time—removes hand flagging and telephoning from your transportation problem. Ask us how we can help YOU.



CANTON AUTOMATIC MINE DOORS

Opens automatically when approaching trip is 25 feet from the door. Closes automatically when last car of trip is 35 feet beyond the door. Many run-a-way trips have safely passed through these doors. Ventilation of mine is interrupted only momentarily. Reversing the air has no effect on the door. Circulation sufficient to remove gases from the mine is secured where Canton Automatic Doors are installed.

MORE AIR AT THE FACE IS WHY WORKMEN LIKE THEM

SURE TO OPEN

NO TRIP TOO FAST

NO LOST AIR

At 50 cents a day it does better work than trappers from $2.00 to $7.00 per day.

A DOOR IN TIME MAY SAVE YOUR MINE

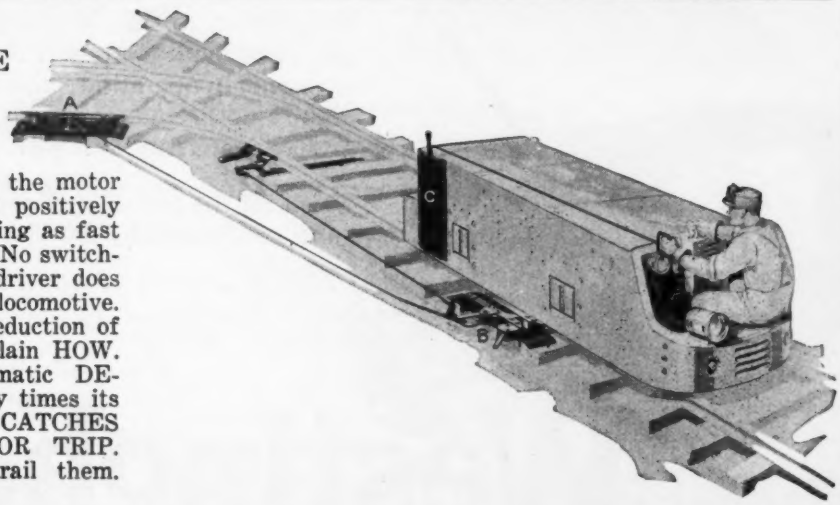
OVER 5,000 IN USE
CAN BE LEASED OR PURCHASED

WRITE US TODAY

SURE TO CLOSE

CANTON AUTOMATIC SWITCH THROWERS

SAVES LIVES
SPEEDS HAULAGE
SAVES MONEY



Latches are thrown by the motor driver accurately and positively while the trip is traveling as fast as it can hold to rails. No switchman required. Motor driver does not leave his seat on locomotive. Saves its cost in the reduction of power. Ask us to explain HOW. Installed as an automatic DERAIL it will save many times its cost every time IT CATCHES RUN-A-WAY CARS OR TRIP. It does catch and derail them. Ask us HOW.

AMERICAN MINE DOOR COMPANY
2061 Dueber Ave. ~ Canton, Ohio

AUTOMATIC LABOR SAVING SAFETY EQUIPMENT

Maximum Effective Performance *at Peak Load!*

It's the peak load that proves the worth of Woven Screens.

It is then, with the crushing system crowded to the limit, that the extra capacity of Woven Screens pays big dividends.

Heavy square-mesh grizzlies or slot screens, ahead of the preliminary crusher, relieve the crushing system of a great amount of useless, wasteful work. With Woven Screens for scalping, the bins get ALL material of satisfactory sizes—the secondary crushers work only on the oversizes. Power wastes from useless conveying and recrushing are eliminated. Excessive fines and dust from useless cleavages are avoided. Both crushing costs and subsequent process steps reflect the efficient performance of the Woven Screens.

Positive Screen Control of both initial feed and circulating load is the basic principle of really economical crushing.

"Getting Results with Ludlow-Saylor Screens" is a 200-page summary of America's latest achievements in screening practice and screen-control of process operations. • • • A copy will be sent free upon request to any reader of The Mining Congress Journal

LUDLOW-SAYLOR WIRE CO.
608 S. Newstead Ave.
St. Louis, Mo.

Please send us Book No. 48-D "Getting Results."

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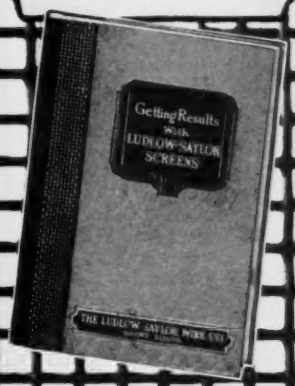

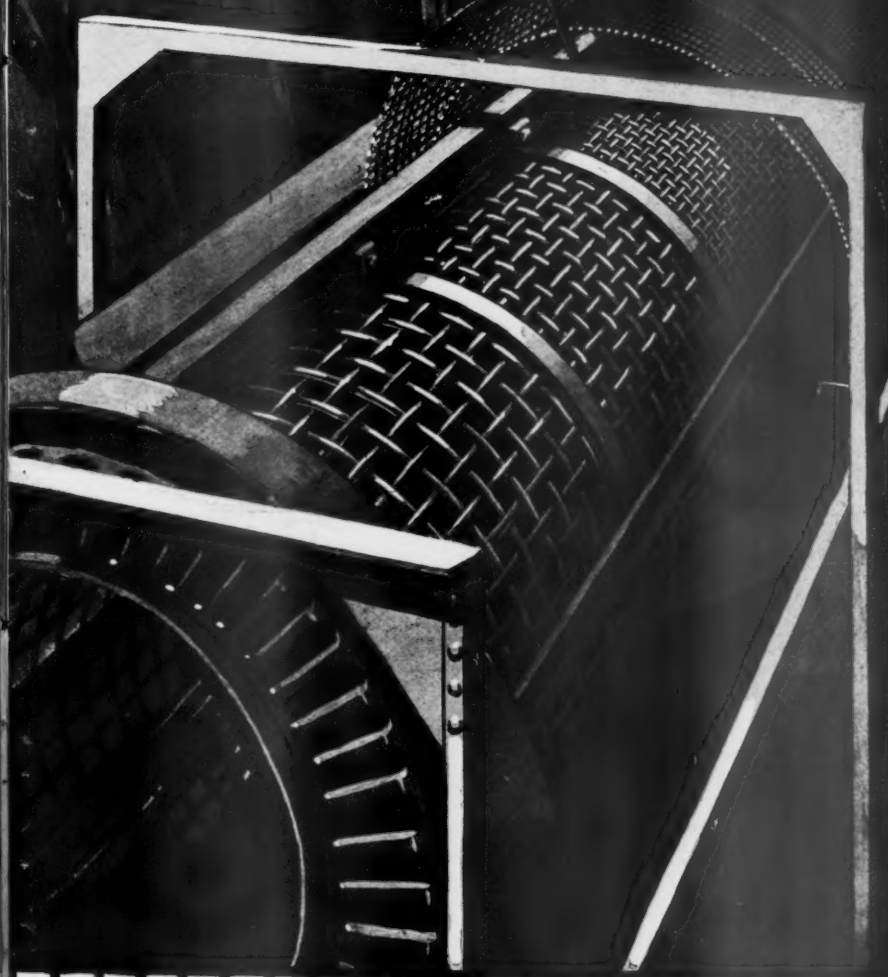

The LUDLOW-SAYLOR WIRE COMPANY ST. LOUIS

608 S. NEWSTEAD AVE.

Properly Chosen Ludlow-Saylor Screens Are Aiding Industries Throughout America Toward Greater Productivity of Plant and Equipment Investment.

Standard process installations do more and better work when feeds and products are positively controlled by effective applications of the RIGHT Wire Cloth.

"Getting Results with Ludlow-Saylor Screens" is a 200-page summary of America's latest achievements in screening practice and screen-control of process operations.

A copy will be sent free upon request to any reader of The Mining Congress Journal

LUDLOW-SAYLOR WIRE CO.
608 S. Newstead Ave.
St. Louis, Mo.

Please send us Book No. 48-D "Getting Results."

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The LUDLOW-SAYLOR WIRE COMPANY
SAINT LOUIS
608 S. NEWSTEAD AVE.

HERCOMITES 2 TO 7

THE GREATEST EXPLOSIVES VALUE OFFERED TODAY OFTEN SAVING UP TO 30% IN EXPLOSIVES COSTS

LOWEST COST PER CARTRIDGE

SAFEST COMMERCIAL EXPLOSIVE KNOWN TO INDUSTRY—GIVES A MINIMUM OF NOXIOUS FUMES

HERCOMITES **are successfully replacing Gelatin Extras and Extra L. F. Dynamites of from 20% to 50% strength at a substantial saving. The table shows the grades of Extras and Gelatins that the new *Hercomites* should replace cartridge for cartridge.**

HERCOMITE 2 is nearest grade to	60% Extra L. F. or 40% to 50% Gelatins
HERCOMITE 3 is nearest grade to	50% Extra L. F. or 30% to 35% Gelatins
HERCOMITE 4 is nearest grade to	40% Extra L. F. or 25% to 30% Gelatins
HERCOMITE 5 is nearest grade to	30% Extra L. F.
HERCOMITE 6 is nearest grade to	25% Extra L. F.
HERCOMITE 7 is nearest grade to	20% Extra L. F.

Write for descriptive booklet. For information on other explosives and blasting supplies see pages 170 to 172 of 1928 Keystone Metal Quarry Catalog.

HERCULES POWDER COMPANY

(INCORPORATED)

Sales Offices: Allentown, Pa., Birmingham, Buffalo, Chattanooga, Chicago, Denver, Duluth, Hazleton, Pa., Huntington, W. Va., Joplin, Mo., Los Angeles, Louisville, New York City, Norristown, Pa., Pittsburg, Kan., Pittsburgh, Pottsville, Pa., St. Louis, Salt Lake City, San Francisco, Wilkes-Barre, Wilmington, Del.

Hercules Powder Company, Inc.,
934 King Street, Wilmington, Delaware

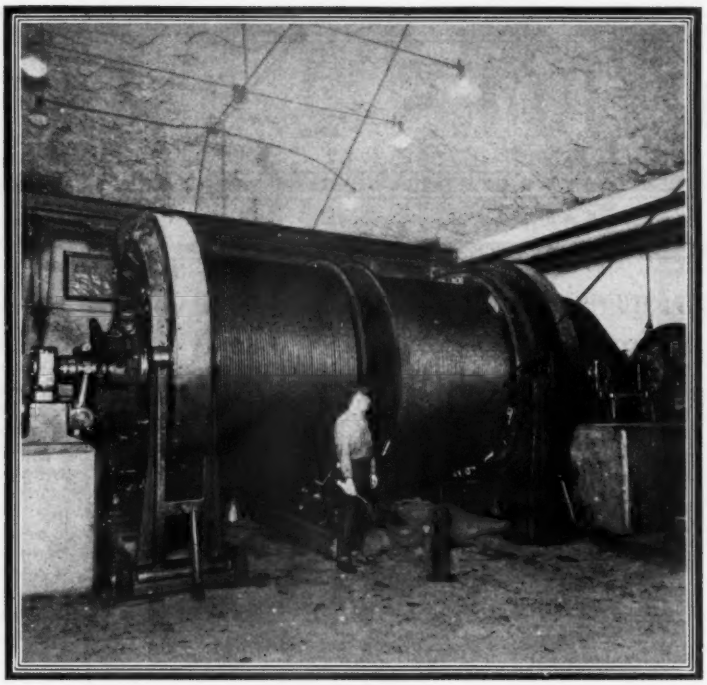
Please send me additional information regarding the new Hercomites, 2 to 7.

Name .....

Company .....

Street ..... City ..... State .....

2279



Lubrication of Mining Machinery

Mining machinery operating underground is subject to extremely severe service conditions. It is frequently exposed to the action of dust, grit and acid laden water. Other conditions vary so radically in the different types of metal and coal mines that great care in the proper selection and application of lubricants is vital to economical operation. There is a Standard Lubricant for every condition and every type of mine equipment.

Mining Conditions Today Prohibit Lubrication Practices of Yesterday

ENGINEERING science has transformed the mining industry in the past thirty years. As mechanical equipment increased in use new methods of lubrication became necessary. The refined and complicated mining machinery of today can not be efficiently lubricated by the methods of a few years ago.

So important has become the correct lubrication of mining equipment that the Standard Oil Company (Indiana) found it necessary to develop ten grades of lubricants for electric mine locomotive requirements alone.

Because it is such an important factor in any mine operation and because it is a problem directly affecting operating costs, Standard Oil Company (Indiana) lubrication engineers have given much attention to the development of proper lubricants for all mining equipment. One of these engineers will be glad to designate the lubricants best suited to your equipment and conditions, and help you with any lubricating problem which may be troubling you.

STANDARD OIL COMPANY (*Indiana*)

General Offices: 910 South Michigan Avenue CHICAGO, ILL.

ILLINOIS	INDIANA	IOWA	S. DAKOTA	N. DAKOTA	MINNESOTA	MISSOURI
Chicago	Evansville	Davenport	Huron	Fargo	Duluth	Kansas City
Decatur	Indianapolis	Des Moines	MICHIGAN	Minot	Mankato	St. Joseph
Joliet	South Bend	Mason City	Detroit	WISCONSIN	Minneapolis	St. Louis
Peoria	KANSAS	Sioux City	Grand Rapids	La Crosse		
Quincy	Wichita		Saginaw	Milwaukee		
				Green Bay		

1509

Cadet Light
Especially desirable for small stopes and roof trimming. Weighs 30 lbs. charged. One full charge burns for 5 hours.

Style No. 2
For use in large stopes. Weighs 37 lbs. empty and 115 lbs. charged. One full charge burns for 12 hours.

MORE LIGHT

means greater safety underground

Safety Engineers approve the Carbic Light for use in metal mines

THE majority of accidents underground occur at the working face, where dangerous conditions are often difficult to detect with the localized light supplied by individual miners' lamps. Mine operators and safety engineers agree that many of these accidents could be prevented if additional illumination were available.

Numerous demonstrations in metal mines have proved the Carbic Light ideally suited for underground illumination. Safety engineers have proclaimed it the most practical means of increasing the safety of working conditions at the face.

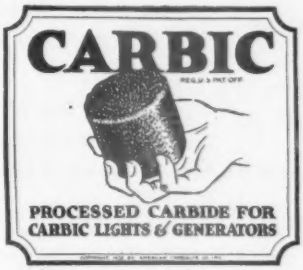
The Carbic Flood Light is powerful

It supplies a pure white light, strong enough to illuminate the highest stope even when filled with fog. Yet miners can work directly facing a Carbic Light because it does not glare.

It is a self-contained unit and can be easily carried about when fully charged. It is so simple any one can charge it in a few minutes. It has unique safety features. The Underwriters' Laboratories Inc. list the Carbic Light as standard.

Thousands of Carbic Lights are in use on the surface for night construction work. 14 years of service have proved its long life and low cost of operation.

If your jobber cannot supply you, write to our nearest office.



Carbic is distributed by the Union Carbide Sales Company through its national chain of warehouses and is sold by jobbers everywhere.

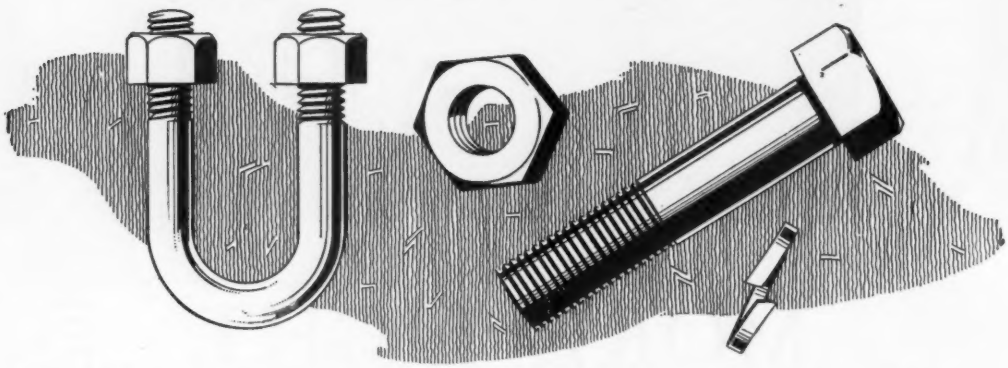
OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation
New York City — Chicago
30 East 42d St. — UCC — Peoples Gas Bldg.
San Francisco, Adam Grant Bldg.

CARBIC LIGHT

TRADE MARK EVERDUR REG. U. S. PAT. OFF.

MANGANESE-SILICON BRONZE

Combines the strength of steel with high resistance to corrosion



EVERDUR nuts, lock-nuts, bolts, U-bolts, washers, etc., are now made by leading manufacturers. These Everdur products possess the tensile strength and elastic limit of steel, are rust-proof and offer high resistance to corroding gases, vapors and liquids.

Specific tests of Everdur have been made on a number of ⅜" bolt rods which were exposed to the elements and kept under stress beyond the elastic limit continually for a period of thirteen months. These rods were strained 1% beyond the elastic limit for the first month, 2% for the next six months and 4% for the concluding six months, with no indication of failure.

Tests made by the Electrical Testing Laboratories of New York on hot headed Everdur bolts, taken at random from a stock of 10,000, showed that the average tensile strength of these bolts was well above 99,000 pounds per square inch.

The American Brass Company manufactures Everdur in the form of rods, plates, sheets, wire, pipe, hot-pressed parts, forging blanks and casting ingots. In addition to nuts and bolts, fabricators are prepared to furnish Everdur rivets, lock washers, woven wire, pipe fittings, castings, etc.

May we send Publication E-2 which contains informative data on the physical properties of Everdur?

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities.
Canadian Mill: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

ANACONDA COPPER
BRASS ANACONDA from mine to consumer BRONZE

DEALER PROFITS LIE IN PERMANENT CONSUMER PATRONAGE

The Consumer Family listens weekly to the **OLD COMPANY'S** *Radio Recitals featuring*

REINALD WERRENRATH

America's Foremost Baritone

THE Lehigh Coal and Navigation Company, producer of Old Company's Lehigh Anthracite, is pleased to announce a series of radio recitals by Reinald Werrenrath.

Mr. Werrenrath has a world-wide reputation as a singer, and his concert-hall recitals are attended by thousands of persons.

There is no radio advertiser who is presenting an artist of higher standing or of greater appeal.

The providing of a weekly song program by so famous and so popular a singer as Reinald Werrenrath cannot fail to create public good-will for "The Best Since 1820" Anthracite, and for the dealer who handles it.

Beginning Sept. 16th
Sundays at 7 P.M.
from these stations:

WEAF . . . New York City
WGY . . . . Schenectady, N. Y.
WGR . . . . Buffalo, N. Y.
WEEI . . . Boston, Mass.
WCSH . . . Portland, Maine
WTAG . . . Worcester, Mass.
WJAR . . . Providence, R. I.
WTIC . . . Hartford, Conn.
WLIT, WFI . . Philadelphia, Pa.
WRC . . . . Washington, D. C.

These recitals will also serve as weekly reminders of Old Company's Lehigh Anthracite to householders.

Every dealer, as well as his customers, is invited to tune in on these recitals and judge of their attractiveness.

OLD COMPANY'S LEHIGH

THE LEHIGH COAL AND NAVIGATION COMPANY
1421 CHESTNUT STREET PHILADELPHIA, PA.
New York - Boston - Buffalo - Springfield, Mass.

OLD COMPANY'S LEHIGH

MINE TIMBERS

ZMA
ZINC META ARSENITE

Z-M-A mine timbers will outlast untreated lumber by many years. Z-M-A unlike most timber preservatives is non-leaching — odorless — non-corrosive and does not effect the natural electrical conductivity of the wood. Z-M-A is a preservative with features that are particularly advantageous for mine timber preservation.

Gulf States Creosoting Company - Hattiesburg, Miss.

Keystone Wood Preserving Company - Philadelphia, Pa.

Piedmont Wood Preserving Company - Augusta, Ga.

Curtin-Howe preservation engineers will be glad to place before all interested parties, the complete facts about the Z-M-A process for mine timber treatment. There is no obligation—write today.

CURTIN-HOWE CORPORATION

TIMBER PRESERVATION ENGINEERS

11 PARK PLACE

NEW YORK CITY

Crozier Bldg., Philadelphia, Pa. *New Orleans Bank Bldg., New Orleans, La.*

Twice or 1/2?

TWICE *the* TONNAGE *or* ONE-HALF *the* COST *per Man*

Tonnage UP or Cost DOWN — which appeals the more to you? You can take your choice with the COSCO Shaker Conveyor System installed in your mines.

More than 300 successful plants operating in American mines are proving the COSCO Conveyor to be a money maker under conditions impossible for any other system.

Built from American materials, to American standards, with exclusive patented features particularly adaptable to American mining methods.

Whether YOUR problem is one of OVER or UNDER production, high or low tonnage cost, inefficient man-power, or what not—let us show you the solution with the COSCO A-20 or B-15 Drives and Troughing, equipped with improved flanged rollers and "Duckbill."

CONVEYOR SALES CO., INC.
299 Broadway, New York

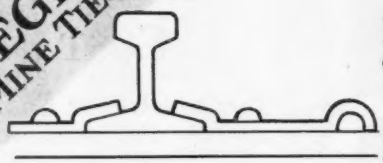
COSCO

Shaker
CONVEYOR

COSCO
B-15 DRIVE
The perfected low-seam drive

"Convey Your Coal the Cosco Way"

Efficient--



Recent improvements in Carnegie Copper Steel Mine Ties have greatly increased their efficiency. Through better distribution of metal, the new sections have greater strength without increase in weight. The broader foot, together with the wide bearing surface and center groove, tends to prevent the tie from sinking into soft bottom.

The outside fastening has also been redesigned so that the flange of the rail will abut against an abrupt face of the clip. This will eliminate any tendency of the rail pushing under the clip.

Carnegie Ties are exceedingly easy to lay. Merely hit the clip and the rail is firmly secured, automatically true to gauge. The copper content of the steel greatly retards corrosion, adding years to the life of the tie. Their shallow depth adds several inches of headroom —an important item in low seams of coal. These are only a few of the advantages that make Carnegie Steel Mine Ties eminently efficient.

May our representative call?

CARNEGIE STEEL COMPANY

General Offices—Carnegie Building

PITTSBURGH, PENNA.

1904

Carnegie Products for Mine Use

+ + +

Copper Steel Mine Ties

Steel Mine Timbers

Wrought Steel Wheels for Mine Cars and Locomotives

Light Rails & Fastenings Standard Rails

Steel Shapes, Plates and Bars

CARNEGIE STEEL MINE TIES

"Who is *that* man?"

"He seems to be mighty interested in that blue-print. What's he got to do with it?" asked the plant manager.

"Why, that design is his suggestion," replied the chief engineer. "He's the Linde Service Engineer. We called him in because we felt our production costs could be reduced. He's designed a set of welding jigs that will increase the hourly output of each welder. You can see what that's going to do to our costs."

LINDE Service Engineers are trained to take full advantage of the economies of the oxy-acetylene process. They can show you how it can best be fitted to your needs. They are a part of Linde Process Service which is free to Linde customers.

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide UCC *and Carbon Corporation*
General Offices: Carbide and Carbon Building
30 East 42d Street, New York
49 PLANTS • 103 WAREHOUSES

LINDE OXYGEN

To that Unsung Hero—
The Man of the Mines!

Superintendents, Electricians and Runners:

In this photograph, the cross effect in the cap light "came" exactly as shown. The photographer has no explanation for the phenomenon.

Our Hats are Off to You!

You are the men who *know* mining machinery—the men who can back up honest opinions with knowledge gained from years of daily experience with the equipment.

No one knows better than you the real worth of mine machinery.

And, so you may know that we do appreciate your opinions and value your friendship, we hereby dedicate this page to you—Men of the Mines!

May we have your Good Will, always.

GOODMAN MANUFACTURING COMPANY
HALSTED ST. at 48TH.
CHICAGO - - - ILL.

Locomotives - Loaders - Coal Cutters

PITTSBURGH—HUNTINGTON, W.VA.—CINCINNATI—BIRMINGHAM—ST. LOUIS—DENVER—PRICE, UTAH

(89)

The saviours of electric traction

ACCORDING to no less an authority than Elihu Thomson, "no single thing had a greater or more direct influence upon the technical success of electric railway machinery than the introduction of the carbon brush as a substitute for the various forms of metal brush." This tribute is, we believe, no less deserved for the entire electrical field than it is for the traction industry. It is true that for certain applications the metal brush has returned, but in considerably modified form, containing considerable carbon; carbon therefore did not merely displace metal brushes, but also brought them back into practicality.

Writing of the early metal brushes on railway motors, Thomson stated: "They were only calculated, under the harsh conditions, to be ground, and to grind the commutator, into dust at a rapid rate (such dust being scattered by the pound along the line of way) with the production at the same time of a flickering greenish illumination under the car, an illumination all the more ghastly on account of the havoc known to be going on and of which it was an unfailing index."

Such conditions made the future of electric railways exceedingly doubtful, as they did that of all other electrical machines of any size. In 1888 Chas. J. Van Depoele suggested trial of a plate of carbon as a brush on railway motors, such a plate having been used successfully on stationary motors. The new carbon brush made its virtues evident immediately. Crude though they were, the early carbon brushes saved the traction industry. One of the first of these was inspected after a run of 5000 miles, when it showed moderate wear, and the commutator none.

The new brushes were quickly applied to motors and generators everywhere. In America, the first brushes to find commercial use were made by the National Carbon Company in 1887. Continuously since then this company has co-operated with manufacturers of electrical machinery in the development of proper brushes.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide UCC *and Carbon Corporation*

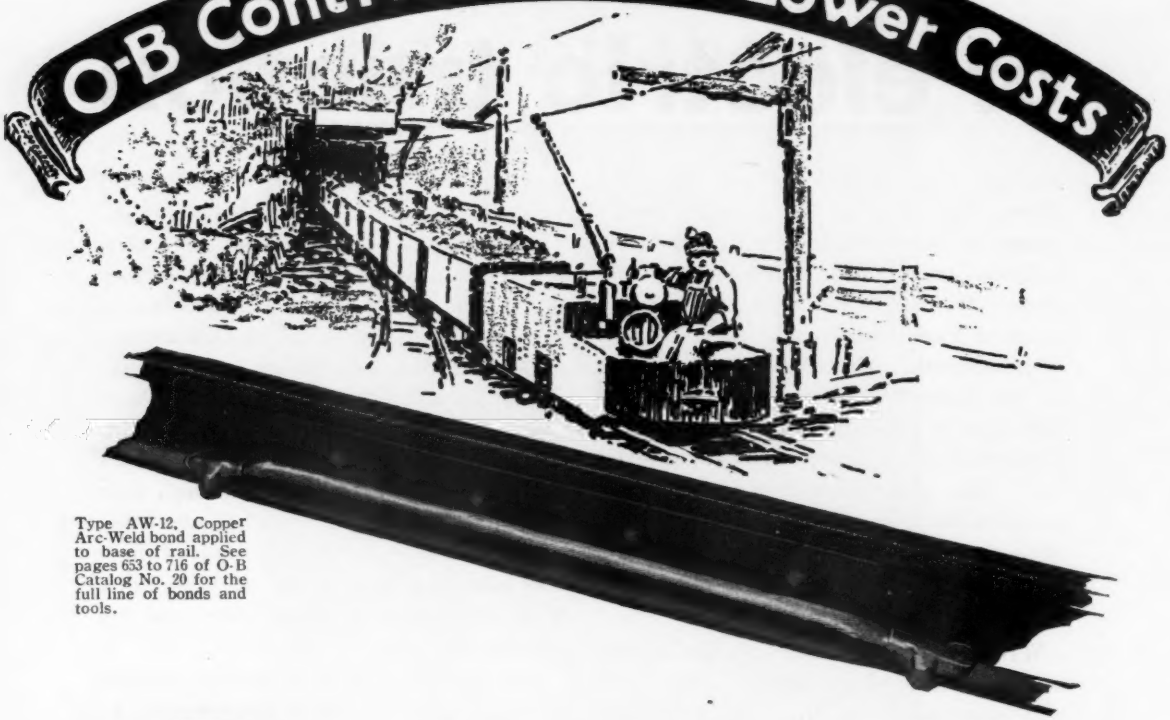
Carbon Sales Division

Cleveland, Ohio SILVER STRAND CABLE TRADE MARK REGISTERED San Francisco, Cal.

Branch Offices and Factories

CHICAGO, ILL. PITTSBURGH, PA. JERSEY CITY, N. J. BIRMINGHAM, ALA.

O-B Contributions to Lower Costs



Type AW-12. Copper Arc-Weld bond applied to base of rail. See pages 653 to 716 of O-B Catalog No. 20 for the full line of bonds and tools.

One terminal of O-B Copper Arc-Weld Rail Bond, Type AW-12. It can be clamped firmly to rail base by the tap of a hammer before welding is started. See page 670 of O-B Catalog.

O-B Copper Arc-Weld Rail Bond, Titon Type. A widely used ball-of-rail bond, for application on standard joints. See page 667 of O-B Catalog.

One terminal of O-B Steel Metallic Arc-Weld Rail Bond, Type AW-13. Can be clamped firmly to rail base by the tap of a hammer before welding is started. See page 671 of the O-B Catalog.

Treat Your Locomotives to a Dash of Full Voltage

RAIL BONDS play an important part in haulage operations. Good bonds mean good bonding—higher conductivity of the return circuit—and thus ample power for the fast movement of trains. With ample power, more trips, and longer trains are hauled in less time with the same locomotive equipment. With this so, it is obvious that rail bonds can shrink ton-mile cost.

Operators who have reduced ton-mile cost with good bonding say that O-B Bonds are the best cost-reducing insurance. Made not only for high conductivity when newly applied, but made to maintain that same high conductivity after years of service—such are O-B Bonds.

Why not treat your locomotives to a dash of full voltage, and yourself to the savings which O-B Bonds make possible? Let your next bonds be O-B Bonds.

Ohio Brass Company, Mansfield, Ohio
Canadian Ohio Brass Co., Limited
Niagara Falls, Canada
918M

Ohio Brass Co.

NEW YORK CHICAGO PHILADELPHIA PITTSBURGH ATLANTA CLEVELAND ST. LOUIS SAN FRANCISCO LOS ANGELES

PORCELAIN INSULATORS
LINE MATERIALS
RAIL BONDS
CAR EQUIPMENT
MINING MATERIALS
VALVES

"*Why, Jim,* if it adds only 8% installed, let's use it!"

"*NOW, Jim, let's take it for granted that Byers Pipe would last longer. The engineers tell us that; and we are convinced of it. Still, 70% difference in cost is not to be ignored, either.*"

"I know, Mr. Jenkins, if you figure that way, 70% is quite a difference; but that's not the way I look at it. Your 70% does not apply to labor, nor fittings, nor anything at all but just pipe delivered in our stockroom. What really interests us is the cost of the system installed. By the time you get your lines working and everything reckoned in, the difference is nearer 7% than 70%. As I size up the case, we'd be paying, say, 8% more for a system that would last 100% longer."

"Are you sure about that?"

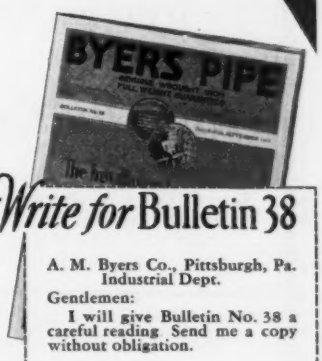
"Why, yes, Mr. Jenkins. Labor, fittings, incidentals and overhead, in getting any such job done, represent 90% of the total cost, as a rule. And if your pipe fails, you don't only lose the 10% you paid for pipe. You lose the other 90% too. Everything has to be done over, of course. Sometimes it's a great deal worse than that; for it's harder and more expensive to replace old work with new, than it is to do a complete job to begin with."

"Why Jim, you're right! It's the cost of the system, installed and working, that we must consider. I wonder nobody ever brought the matter to our minds in just this way before. Check up your estimates again, and let me see the figures tomorrow. If the installed cost is only 8% more, I'll approve it."

A. M. BYERS COMPANY
Established 1864 Pittsburgh, Pa.
Distributors in all Jobbing Centers

Write for Bulletin No. 38
It is a complete cost analysis of a large variety of industrial pipe systems and dispels the fallacy that genuine wrought iron pipe is too costly to use. A copy will gladly be mailed on request.

the *Spiral Stripe*
protects you against mistakes and substitution
Also look for name and year rolled in metal



Write for Bulletin 38

A. M. Byers Co., Pittsburgh, Pa.
Industrial Dept.
Gentlemen:
I will give Bulletin No. 38 a careful reading Send me a copy without obligation.

Name _____

Address _____

_____

BYERS PIPE
GENUINE WROUGHT IRON

Do You Think You Can't Use Permissible Explosives?

YOU may have tried Permissibles in your mine and found them either too strong to make good lump or too expensive. But that was before Hercoal-F, an entirely new type of explosive, was invented.

Until you have tried it, you can't be sure that this new powder will not improve your blasting. It is doing this in mines where only Black or Pellet Powder have been used successfully before.

In its action, Hercoal-F is similar to Black or Pellet Powder; it costs no more for an equal volume; it makes very little smoke; its fumes and its water-resisting qualities are superior to those of Black or Pellet Powder. It has the advantages in safety that go with all Permissibles.

Write for full information and prices.

HERCULES POWDER COMPANY
(INCORPORATED)

Sales Offices:~Allentown, Pa., Birmingham, Buffalo, Chattanooga, Chicago, Denver, Duluth, Hazleton, Pa., Huntington, W. Va., Joplin, Mo., Los Angeles, Louisville, New York City, Norristown, Pa., Pittsburg, Kan., Pittsburgh, Pottsville, Pa., St. Louis, Salt Lake City, San Francisco, Wilkes-Barre, Wilmington, Del.

Hercules Powder Company, Inc.
990 King Street, Wilmington, Delaware
Please send me booklet describing Hercoal-F.

Name _____

Company _____

Street _____ City _____ State _____

HERCOAL-F

COUNT:
About 500 Cartridges (1¼" x 8") per 100 lbs.

COMPARED WITH BLASTING OR PELLET POWDER:

STRENGTH
—the same

FUMES
—much better

COST
—no more

SAFETY
—Hercoal-F is a permissible explosive.

For further information on other explosives and blasting supplies, see pages 712 and 713 of the 1927 Keystone Coal Mining Catalog. 1439

"Where's the Other Drill?"

An 8 x 10 tunnel heading, with one drill at work at one rib and a round of holes partly finished, loaded and wired, but no second drill in sight.

"Where's the other drill?" asked the photographer.

"Other drill H—!" said the foreman, "what do we want another drill for? We are finishing the round in half a shift now, with this Sullivan Water Drifter, and putting in 22 to 28 6-ft. holes."

If you have a rock drilling job of any sort, depend on Sullivan Equipment. Ask for any of these Catalogues that interest you.

	Bulletin No.
Rotator Rock Drills	81-S
"L-8" Light Rotators	81-T
Auger Rotators	81-O
Sinker Rotators	81-Q
Drifters	81-M
Stopers	81-G
Drill Tunnel Carriages	81-I
Drill Sharpeners	72-J
Drill Steel Furnaces	74-C

Air Compressor Catalogues (on request)

SULLIVAN WATER DRIFTERS

are just about the fastest tunneling drills that you can pick out. In addition to that they are light, easy to handle, and being made of the best materials and by manufacturing methods which have been perfected in thirty-five years of rock drill manufacture, they are always on the job and cost but little for repairs.

When you strike your next tunnel job, equip it with Sullivan Water Drills and keep your footage up and your costs down

SULLIVAN TRADE MARK

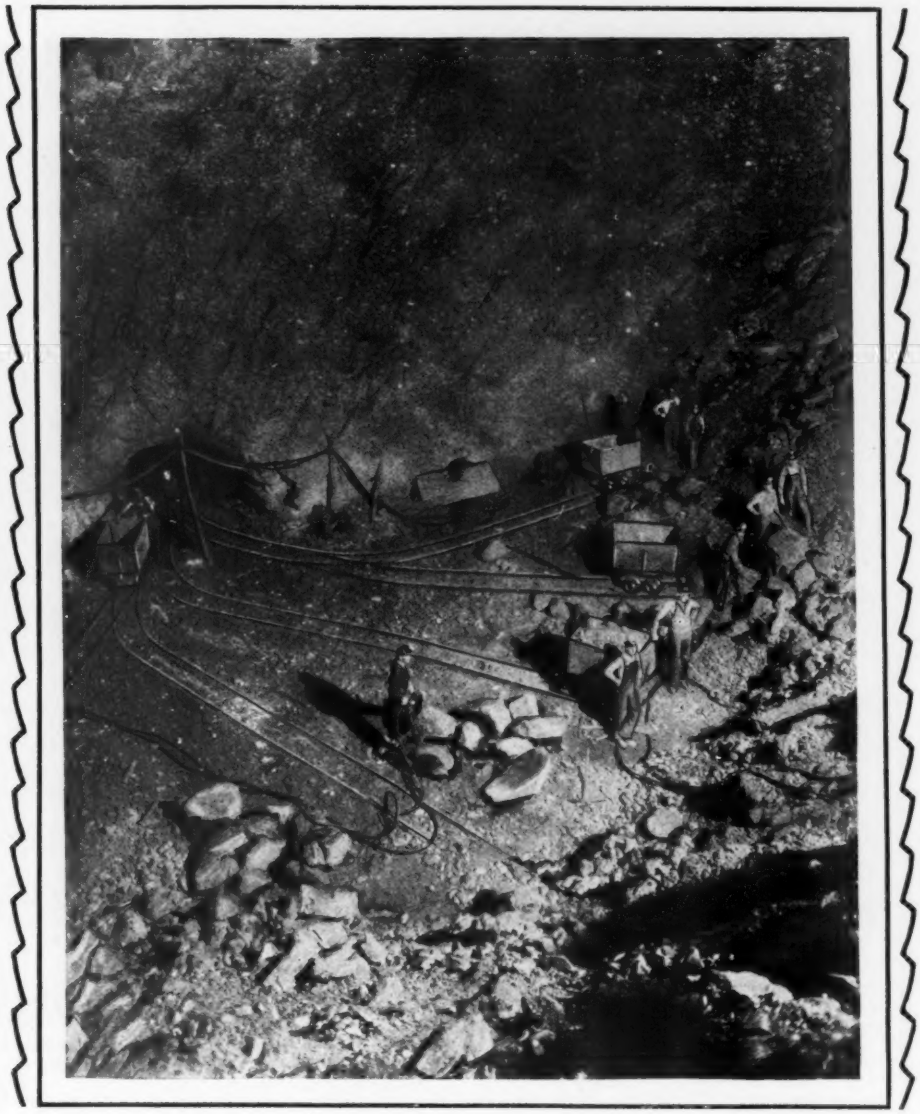
SULLIVAN MACHINERY COMPANY

148 SOUTH MICHIGAN AVE., CHICAGO, U. S. A.

Boston, Cleveland, St. Louis, Birmingham, New York, Pittsburgh, Knoxville, Dallas, San Francisco

Denver, El Paso, Duluth, Los Angeles, Toronto, Salt Lake City, Spokane, Seattle, Scranton, Vancouver

In spite of high water



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Plasticity. The plastic consistency of du Pont Gelatins enables them to be loaded effectively in uppers.

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Du Pont Gelatin 20% to 90%: Dense, waterproof and plastic. Minimum of noxious fumes. When properly confined, these gelatin dynamites are about 10% quicker in their action than the corresponding grades of straight dynamite. Low-freezing.

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The
MINING CONGRESS JOURNAL
**A Monthly Magazine—The Spokesman For The Mining Industry—
Published By The American Mining Congress**

VOLUME 14 | September, 1928 | No. 9

Editorials

The Meeting At Los Angeles

MEETING at Los Angeles, September 10 to 13, in its annual convention, the Western Division of the American Mining Congress will present a program of much importance to the mining industry at large and to the western section particularly. Economic problems will occupy an important place on the program including a discussion of stabilization of production and prices of metals, the necessity for an adequate protective tariff, state and national taxation, greater efficiency in producing gold, together with discussions of practical operating problems.

The copper industry is fairly well stabilized. But the silver, lead, zinc and non-metallic industries of the West need assistance, in spite of the fact that the metal industry as a whole is more prosperous than it has been for years. A higher tariff on certain base metals, and a united movement to stabilize production with due regard to market demand, would accomplish much good.

Geophysic prospecting, which has made rapid advances during the past year, will be discussed by engineers who have employed this interesting and unique method of discovering ore bodies. Two sessions of the convention will be devoted to the discussion of practical operating problems including Ventilation, Problems of the Supply Department Power, and Cooperative Mining Development.

These annual meetings give the western miner an opportunity to present his problems and to secure the cooperation of his fellow operators in solving them. They have proved of great benefit, and the meeting scheduled promises to be of greater importance than its predecessors. The American Institute of Mining and Metallurgical Engineers and the California Development Association are holding simultaneous meetings, and cooperating in every way in making the event an outstanding success.

If the convention out of the array of material to be presented shall evolve a program for the development of a plan for regulating production to meet market conditions, that alone would prove a real boon to the industry.

The Legislative Outlook For Metals

LEGISLATION pending before Congress, dealing with questions pertaining to the metal mining industry, is all of a constructive nature, designed to improve and simplify the administration of the income tax, to protect the industry's rights in the settlement of war minerals claims, to relieve the economic handicaps on the gold and silver mines, to encourage and stimulate gold mining and mine development generally, and to insure to the several branches of the mining industry adequate protection under the tariff law.

Perhaps the most important subject likely to be considered at the next session is that of mine depletion. Under the present and previous revenue laws, all mines that could estimate with a fair degree of accuracy their ore reserves as of March 1, 1913, have received, and are receiving, fairly reasonable allowances for depletion based upon March 1, 1913, values. But mines that were only partially developed as of March 1, 1913, or that are located in districts where geological conditions made the measurement of ore reserves practically impossible, or that have discovered new ore deposits or reserves since 1913, which do not fall within the technical construction of the provisions of the revenue law relating to discovery, are being compelled to operate without any allowance or with inadequate allowances for depletion.

It should be apparent to Congress that mines which, because of geological conditions, cannot prove the extent of their ore reserves as of a basic date, such as March 1, 1913, should not be denied the "reasonable allowance for depletion," provided for by law, while competing mines, that can secure a fair estimate of ore reserves and values, receive the full benefit of the deduction for return of capital as the ore is mined. Therefore, Congress should give favorable consideration to the proposal for a percentage-of-income basis for mine depletion similar to that provided for oil.

With this as a major and fundamental proposition for improvement of the metal mining situation, and with other measures for the encouragement and stimulation of gold mining, and for improvement of economic conditions in gold and silver mining, Congress has before it a definite and wholly constructive program for the metal mining industry. And present indications are that the outlook for this program is favorable.

Profitless Investigation

DURING the last five years there have been numerous investigations by the legislative, executive and judicial branches of the Federal Government, some of which involve the mining industry in all of its branches, while others dealt with particular industries. If any real good has been accomplished by these investigations, it is not as yet apparent to the laymen or to those engaged in the mining industry. For example, the investigations of the coal industry have accomplished nothing of immediate or apparent benefit to that industry or to the country at large. One result has been continued agitation for Government regulation and control, and even Government ownership of that industry. This agitation has not aided the coal industry.

It stands today just about where it stood before the investigations were made. Coal has been used as a football of politics, and our statesmen are still at sea concerning what, if anything, can be done to improve conditions through legislation.

The special Senate investigation of the Bureau of Internal Revenue which was headed by Senator Couzens, of Michigan, finally was centered upon the tax returns of the mining industry. The effect of this investigation was to delay the settlement of tax returns for the war tax years from two to five years longer than otherwise would have been the case. Many returns involved large overpayments, and others involved large underpayments of taxes. While this investigation was in progress it was practically impossible to get the personnel of the Bureau of Internal Revenue to take final action upon any case involving a large sum of money, especially if that action was in favor of the taxpayer. Fortunately, this investigation did not leave its imprint upon either the 1926 or 1928 revenue acts. It accomplished no particular good and did no particular harm.

The investigation made by the Senate Commission on Gold and Silver Inquiry was intended to awaken Congress to the need for sympathetic consideration of the problems of metal mining, particularly in the case of gold and silver. This committee functioned with the full cooperation of the mining industry. Its records and reports showed that the mines of the country held nothing back in the way of information, and voluntarily furnished everything that was called for by the commission. This investigation was conducted in an open manner and with a clear understanding of its purposes; but no legislation has been passed as the result of the studies made and the facts developed. Therefore, the metal mining industry has not yet been able to determine whether or not it has been helped or harmed.

The oil industry has been subjected to a series of investigations by Senate committees, by the Federal Trade Commission and by the Federal Oil Conservation Board. No tangible benefits from these investigations can be shown. If anything, the general public is more confused than before concerning the issues involved. Likewise, our statesmen appear to be confused, and certainly do not seem to be better equipped to visualize the oil situation or to evolve a program involving legislation or any other measure of dealing with the question that would improve existing conditions.

The investigations of the power industry have seemed equally devoid of any beneficial results. The most they have accomplished up to the present has been to provide fuel for the fires of socialistic propaganda in favor of Government regulation and ownership as against private ownership and management. The development of hydroelectric power in this country with private capital has done more to raise the American standard of living, create opportunities and incentive for industrial expansion, encourage the development of all natural resources of the United States, and bring the nation's far-flung areas into a compact national existence than any other single industrial project of nation-wide scope. If evils exist in the power industry, the ways and means surely can be found to correct them without subjecting the entire power industry to public malignment, political blackmail, or any other injurious condition.

It has seemed to be the practice of investigators to make public and emphasize most strongly all the unfavorable features developed by their inquiries, leaving the splendid accomplishments of an industry, and the benefits derived by the public from the growth of an industry, undisclosed. Where everything in the nature of criticism is given publicity and everything in an industry's favor is withheld, the public imagination and opinion is influenced against an industry, and, instead of good, only injury can result.

It is fortunate for the country that our natural resources industries have continued to forge ahead, carrying on necessary development and expansion programs to keep pace with the nation's growth, undeterred by the undermining influences that have been at work to discredit those greatest of all factors in our nation's progress—private ownership, initiative, and management.

Two Sides To Every Controversy

EACH side to a controversy has the right to tell its story, and in the manner which each may feel efficacious. When one side attempts to enhance its story through malignment of the other, and attempts to show that its opponent, while employing similar means, is guilty of gross indiscretion, if it does nothing more, it defeats its own purpose.

For many years the proponents of Government ownership and of private ownership of industry have engaged in a wordy battle. So far the demonstrated value of private conduct of business has outweighed the unsuccessful experiments in Government ownership in such a manner as to leave little defense to the advocate of popularized industry.

The Public Ownership League of America, and others of similar purpose, have raised a cry against the methods employed by private industry in presenting its merits to the public. Their particular object has been the power industry, which is now under investigation by the Federal Trade Commission on charges growing out of the statements of the socialistically inclined element in this country.

Recently a bulletin issued to its members by the Public Ownership League announced the purposes of the League, and detailed its activities in behalf of Government ownership. They include "preparation of special literature; conducting of educational campaigns; supplying speakers and utility experts; engineering and legal service; conducting of numerous municipal ownership campaigns, conducting fight for Muscle Shoals, Boulder Dam and other federal projects, preparation of editorials to be used in local papers setting forth the advantages of publicly owned utilities." They add, "there is not a city, town or village in the United States now that the Public Ownership League cannot reach with an active, aggressive representative within 24 hours." Add to this their program for "reaching every member of Congress," their radio broadcasting of the League's message, and other interesting methods of reaching the public, and you have a program as ambitious as any advocate of the private conduct of business could conceive.

No one will deny the League the right to tell its story in the most effective manner. No one will quarrel with its ambitious program. No one will even doubt its sincerity, and some will listen to its story just so long as it is willing to accord to the other side the same rights and privileges it possesses. But when it seeks to destroy the story of the proponents of Private Industry through misrepresentation, and yells "stop thief" when the so-called transgressor is but using its same methods, all sympathy for it and its cause ceases.

We have long advocated the policy that has made this nation great: the policy which recognizes that only by the preserving of initiative and enterprise, and the

granting of equal opportunity for all, can this country hope to maintain its past high standard, and to fulfill the promise of its future.

There is nothing in the history of this or any other country which will warrant our adopting the experiment advocated by the Public Ownership League. Nothing could happen to this country, which would be a greater catastrophe for the workers than to place their jobs in the hands of politicians, and to stifle industry through bureaucracy.

The cause of the Government ownership advocate is weak, but it is made weaker still when they attempt to show that the opposition is criminal in using the defense that they themselves utilize.

Proper Distribution of Labor

AFTER a bitter labor struggle in Great Britain, the inevitable has been recognized and accepted. Laborers, instead of staying in one place, starving and fighting in an effort to enforce an uneconomic situation, are migrating to fields where there is a scarcity of labor, and where there is reasonable hope of earning an honest living.

While in this country we have avoided the deplorable unemployment dole, we have been, and still are, facing the condition of communities overrun with unemployed labor, while certain other districts are seeking their services, and for want of it, are forced to employ foreign labor. This is particularly true in the great agricultural and mining regions of the west, where there is room for a considerable portion of the surplus coal miner, for instance. The surplus bituminous coal miner is a drug upon the market. He is a source of continual worry to his community and to the country, not because he is a coal miner, but because there are too many of him. If this surplus labor could in some manner be transferred to the metal fields, much would be accomplished in stabilizing industry.

The American Miner

THE metal mining industries of the West and Southwest need miners. There has been, for a number of years a shortage of American miners in this section, and the shortage has been made up from Mexican sources of labor supply. Western metal mines prefer to employ Americans and to establish strictly American camps. Congressman Douglas, of Arizona, in commenting upon this situation, points out that "twenty-five years ago an American was attracted to mining in the West because there was the speculation of discovering a mine of his own. The West was new. The deposits had not all been discovered; the outcrops appeared upon the surface, and they were easily distinguishable. But today, if new mines are to be discovered, they must be discovered through an expenditure of large capital. Therefore the lure which attracted American miners to the Southwest twenty-five years ago ceases to exist."

However, the mines of the West and Southwest would give employment to miners from the coal mining states if they were available. And the fact that steady employment could be secured by thousands of these miners ought to be an inducement. Besides, the western mines have developed methods and conditions of safety that are unequalled. Facilities for recreation and education also are good and the opportunities offered far surpass those of the congested districts of the East.

Our mines should be manned by Americans. And American miners can see to that, if they will. It is because of necessity, and not by choice that the shortage of American miners in the Southwest is being filled by miners from Mexico.

Progress From the Strike

NOT a great deal of progress has been made since the agreement with the United Mine Workers of America which permits of separate wage agreements. The situation in Illinois is one of deadlock, and in Indiana, there has been no agreement although the operators have done their best in both these states to come to some agreement with the local unions. There is no greater indication that the Ohio and Western Pennsylvania operators will abandon their stand for the open shop than there was a month ago. Mines are being opened in Ohio, and the western Pennsylvania field is maintaining production, and establishing new records for non-union operation.

In Illinois the strike has been a long and costly struggle. Only a very small percentage of the mines could operate under the Jacksonville scale, and less than one-third of the union miners in that state have been employed, leaving many thousands without the benefit of jobs. The operators have been in an even worse condition, because they have seen their markets taken away from them, their mines idle, their equipment depreciating, and the tonnage from the state decrease by half. Many are facing bankruptcy unless the present negotiations give them an opportunity to recoup. The situation in Illinois is extremely difficult, and it will take courage and co-operation on the part of both the union officials and the operators to reach an agreement that will place this great mining state back upon a sound footing.

The situation in Indiana is no better than in Illinois. The proposed wage agreement has been rejected by the miners. Negotiations are off. But the operators have at least made a sincere effort to reach an agreement. In reading their proposal it seems little short of amazing that the owners of a property should be forced to ask for the things which were specified; that it is necessary for any industry to declare a "bill of rights." It seems equally incredible that any coal operator must negotiate for the right to employ and discharge his men for cause; that he may or may not use machinery in recovering his product; that "no restrictions shall be placed upon the amount of coal a machine may mine"; that the selection and control of men to perform any class of work shall rest with the mine management, and that the operator shall have the right to direct the working force of his property. Yet these things have not only been asked for, but so far, have been refused by the miner.

The coal industry of Illinois and Indiana is in a bad way. The United Mine Workers of America have placed them in their present situation. It can not obtain much longer. Even in the face of this apparent deadlock, hope is visible, indications are that things will shortly be brighter for these two states.

The Advancing Giant

THE coal industry has started a new line of march toward prosperity. For the past few years the industry has been travelling in a circle, raising a cloud of dust now and then but actually getting nowhere. Those who have recently broken out of the circle and have started forward in a straight line

have not all reached their objective, but most of them have found the going easier and to them the prospects ahead seem brighter.

In 1927 most of the approximately 500,000,000 tons of coal produced came from about 1,600 mines, in spite of the fact that the industry boasts of more than 7,000 operating mines. Of these 1,600 mines it is estimated that at least 200 are now operating to some extent with mechanized loading. It is true that 200 is not a large proportion of 1,600 and it is a still smaller part of 7,000, but the important fact which these figures show is—not that 6,800 mines *are not* mechanized, but that 200 *mines are.*

There are now few mining districts where the influence of mechanized loading is not being felt, and many coal operators now realize that the time is fast approaching when mechanized loading will produce such a high proportion of all coal mines, that hand loading will not be able to compete or exist except in a few favored mines or localities.

Everywhere in the industry one hears the marching wheels of mechanical production. Consolidation of mines, with concentration of production means mechanization. It is here to stay. Only through its adoption can large production be achieved. This is the day of mass production, concentrated systems, and highly specialized organization. Companies that formerly employed many executives have found that through a plan of mechanical production they are able to consolidate positions, reducing their executive personnel, and increasing their efficiency. What they have done in the executive field will be eventually carried on down the line. The growth of mechanization is steady. It is the Marching Song of industry on its way to prosperity.

The Value of Supervision

GENERAL underground supervision is an important factor in the cutting-the-cost program of the mining industry. H. A. Treadwell, General Superintendent of the Chicago, Wilmington and Franklin Coal Company, in a paper presented in these pages recently gave a number of important reasons substantiating this statement.

He points out that, "Mass production has been found to be the solution of conditions arising from the highly competitive market in all of industry today. This increase in capacity has necessitated changed methods of supervision. Big daily tonnages have thrown the single man-managed mine out of the reckoning but the good features of the personal contact have been carried over in the successful supervision systems of large mines."

Employing a thousand or 1,200 men, the mine manager today must delegate to subordinates, directly responsible to him who have ability to handle them, the matters of machine, motors and wires, safety, and haulage. The men in charge in each of these sections is today what the old-time small mine manager was. He alone is responsible for everything, including the safety of the men and the property. Cost of production, amount of recovery, amount of development work, accidents, their causes and prevention, in fact, all results are a part of his responsibility.

In modern mining an efficient and intelligent supervision has become a necessity—particularly for the larger operations. In smaller mines this necessity may not be quite so apparent, but the value and return for adequate supervision is just as great whether an operation employs 1,000 or 100 men. The day of the "mine that runs itself" is passing and those who recognize this will find Mr. Treadwell's article of great interest.

No Large Unemployment

THE most striking commendation of the business machinery in the United States lies in the fact that we have escaped large unemployment. At this time there is evidence of small unemployment in certain parts of the country, but in other parts there is a shortage of labor.

The enormously increased productive capacity of the nation developed for the meeting of war requirements, through a comprehensive business system which has been supported by a wise administration of public affairs, has postponed until now any indication of unemployment. The result has been to make available to the people as a whole increasing luxuries in addition to the necessities of life.

The philosophy which has led to opposition to the increased labor-saving devices in order that the wage earning class might be deprived of employment has been shown to be utterly fallacious. Every new invention looking to greater comfort or amusement has led to a new business development calling for the utilization of the men who have been displaced by machinery in some other line.

But for these marvelous new developments, the recessions from the war requirement period would have brought in its train immense unemployment and a business panic which would have been more severe than anything before known. The fact that we have for the past 10 years been getting away from war production levels without calamity is a lasting tribute to the business system which controls the destinies of this country.

American Prosperity

IT IS little wonder that Europe is casting longing eyes at America, and delving into the reasons for our prosperity. Writers and economists from our neighbors across the seas, faced with the bald fact that the per capita production of labor in the United States is so much greater than in Europe, are attempting to show that our methods will lead us to destruction, and to sow the seeds of discontent here by claiming that the adoption of machinery for hand labor will produce fewer jobs and an inferior class of people.

Statistics comparing the situation here and abroad are interesting, and extremely enlightening. The United States, for instance, with only a little over half the combined population of Great Britain, France, Germany, Italy, and Belgium, produces twice as many goods as all five of these nations together. The annual national income of the United States is five times as great as that of England, nine times greater than Germany, thirteen times greater than France, and twenty-two times greater than Italy, while the per capita income of the United States citizen is almost double that of England, four times greater than France, four and one-half times greater than Germany, and more than five times greater than Italy.

Why are these things true? Because with the rapid growth of America, mass production was a necessity, and

the substitution of machinery for hand labor instead of being a curse has been a blessing. It has provided the worker with luxuries undreamed of by his European brother, which luxuries have created new industries to give employment to labor displaced by the machine.

These High Wages

ALONG the same line the statistics recently given out by the Bureau of Labor Statistics of the Department of Labor, are equally enlightening. In Europe, the daily average wage of a bricklayer is about $1.50; in the United States it is $12.56. European carpenters receive an average daily wage of $2.00 as against $10.16 in this country. Coal miners receive approximately $2.25 per day, as against an average of better than seven dollars here. Similarly striking contrasts are made in other trades, and in various industries, and both current wages and living costs are compared with wages and living costs in 1913. In 1926 wages were 129 percent higher than in 1913, while the cost of living in the same year was but 75 percent higher.

High wages have increased the Nation's buying power. Products of manufacture that in 1913 were considered luxuries are now regarded as necessities of life by American workers. New industries have sprung up creating new fields of employment, and as we advance still greater avenues are open to the American worker, who today has at his disposal facilities that were available only to the very wealthy a generation ago.

The protection of American industries and wage earners by the tariff is no longer a question of political expendiency, or an experiment. Its efficacy has been demonstrated.

Labor and Politics

LABOR presented a program to the national political conventions this year that received marked consideration at the hands of the leaders of both great parties. Their platforms show the shaping influence of labor's program, and each must have vied with the other in attempting to satisfy the demands of that program.

With respect to the Anti-trust Law, the Democratic platform holds that labor should be exempt. The Republican platform is silent on this point, but both platforms agree that injunctions in labor disputes have been abused. Both favor the principle of collective bargaining, the restrictive immigration policy, legislation for the rehabilitation of the coal industry, maintenance of a high standard of wages, increased pay and more liberal retirement privileges for Federal employes, and further relief for disabled war veterans.

The Democratic platform does not specifically favor ratification of the Child Labor Amendment, but asserts that protection of children is an important national duty. Also it favors legislation designed to prohibit interstate sales of goods manufactured by convict labor. It favors a more liberal compensation law for Government employes. It favors appropriations for Government construction work as a measure to relieve unemployment.

On the question of industrial conscription at any time, the Democratic platform is silent; but the Republican platform believes "that in time of war the Nation should draft for its defense not only its citizens, but also every resource which may contribute to success." The Republican platform pledges the continuance of efforts to maintain the present standard of living and high wage scale, while the Democrat platform holds that tariff legislation will be based "on maintenance of legitimate business and a high standard of wages." Both these statements recognize the importance of the protective tariff to the maintenance of a high standard of living and a high wage scale. However, just what is regarded as "legitimate business" is not disclosed by the Democratic platform.

Practically speaking, labor's entire program is covered in one form or another in both political platforms. For this reason there is little likelihood of any of the issues effecting labor becoming an issue in the campaign between the two parties. It will be of interest to see how far the party elected will go in carrying out the pledges of their platform. Much of the legislation thus favored is of a socialistic nature. Its enactment would involve the creation of more bureaus and would take more money out of the pockets of the taxpayers. Some of it may be necessary; but as to most of it, the country will get along just as well, and perhaps better, if it is defeated.

The Cost of Government

THE tentative budget of the United States Government for the fiscal year beginning June 30, 1930, is approximately five hundred millions higher than the cost of Government for the current year. The cost of running the Government of this country is better than three billion dollars annually.

The Coolidge administration has made a specialty of reducing the cost of Government, attempting to bring down expenditures, cut appropriations, reduce taxes and pay off the public debt. The creation of the Bureau of the Budget was in the interest of economy, and its duty has been to suggest how the funds may be allocated to each department and activity of the Government and come within the total specified as the amount available to run the Government.

Congressman Guy U. Hardy of Colorado, in a carefully prepared address upon the cost of Government says that although the Budget Bureau has done splendid work, few appreciate it * * * "the demand for appropriations and for new laws requiring appropriations come from many and for everywhere. Every department of the Government wants to expand. The Army and Navy want more men, more ships, more equipment, better quarters. Every town and city wants public buildings and air mail. Every river and harbor is a possible drain on the Treasury. Every man on the public pay roll would like increased pay. And nearly everybody, everywhere, has something in his mind which he thinks the U. S. Government ought to buy, build or pay for."

Mr. Hardy insists that in spite of all this organized demand upon the purse strings of Uncle Sam, the taxpayer, who must pay the bill, does little or no protesting. It is quite apparent that the American public has given little thought to the question of what it is costing them to run the Government.

This may be because of the vastness of the Government, and the inability of the average taxpayer to grasp the meaning of a budget of approximately three and one-half billions of dollars, and particularly his relation thereto. When Mr. Average Man pays his taxes, in comparison with the billions required, the amount is infinitesimal; it may seem a lot to him, and unquestionably the total represents a vast sum for government, but it does not occur to him to protest the issue.

We are a great country, vast in resources and industry. Obviously the cost of handling such an enormous

business, is considerable. There are few citizens who would care to see Uncle Sam penurious, to see him underpay his servants, to leave himself unprotected against enemies, and to neglect his rural communities through refusal to build proper Government housing for post-office and Government business.

A giant requires an enormous amount of food and fuel and equipment. We should not complain in feeding, clothing and caring for the great UNCLE SAM who has given us our opportunity, our freedom and the greatest Nation on earth. It is not the amount we spend for government that matters. It is the efficiency used in the spending.

State and Local Government Cost

THE taxpayer seems just as lax in his interest in state and location taxation. So much publicity has been given to the drastic reductions and economies in Federal expenditures, and reductions in Federal taxes, that little or no attention has been paid to the enormous increase in state and local expenditures.

During the period since 1921, Federal taxes have been reduced nearly $2,000,000,000; but state and local taxes have been increased by approximately that amount. Therefore, there has been no relief in taxes. On the contrary, a greater burden has been placed upon the rank and file of American citizens—the small-property owner, the farmer, and the local business man. These classes paid little or no Federal tax, even when Federal taxes were at their peak; but they all are taxed by their local governments.

The responsibility for what occurs in the states and their political subdivisions rests with the taxpayers and voters. While the Federal Government has been saving and economizing, the taxpayers have voted for bond issues and new public projects of every sort; and they have not insisted upon a careful supervision over or a strict accounting for state and local expenditures. In most instances, the voters do not know whether economy or extravagance has prevailed.

For 1921, state and local taxes totaled $3,933,000,000; Federal taxes totaled $4,905,000,000. For 1926, state and local taxes totaled $5,348,000,000, and Federal taxes $3,207,000,000. These figures tell the story of what has happened during the last seven years. If the local taxpayers want more money spent by their state and local governments, they should be willing to pay for it; but if they want economical administration of local public affairs, and want taxes reduced, they will have to put forth an intensive and concerted effort to that end.

Local taxpayers' associations are excellent agencies through which taxpayers may acquaint themselves with the local administration of public affairs, and are weapons with which they can enforce honesty and economy in the handling of public funds. It is to the state and local governments that agriculture, the home-owner, the laboring man, the local merchant, and the small business man must look for relief from the burdens of taxation.

Improvement in Metal Marketing

ONE of the greatest problems confronting the producer of minerals today is distribution—the marketing of his product. In some industries this problem is being met by the creation of better distributing agencies, and through the consolidation of properties. The Anti-Trust laws, of course, prohibit the banding together of operators with a view to controlling prices and production, but there is nothing in the law which prevents the creating of selling agencies, and the banding together of operators to correlate and disseminate information concerning their industry, and its possible markets.

The copper industry has made notable progress in solving its marketing problems during the past year. Through the creation of the Copper and Brass Research Association, and the Copper Institute, the industry has been able to in a measure control the supply of copper and to create a demand for the metal. Information has been made available to the industry which has enabled it to develop new markets and to take advantage of present market conditions. According to an article in this issue, the outlook for the copper industry is on the up-grade, with the expansion of the electrical industry and the large development in the water power field, each requiring large volumes of copper for transmission lines.

The silver industry is more restricted in its marketing processes, in that it is intimately associated with Government regulation, trade balances, industrial activities and speculation in every part of the world. Nevertheless new markets are being developed for this metal, and serious consideration is being given to its marketing problems.

The most interesting factor in the status of these metals is the constructive manner in which they are striving to solve their problems. The gathering of accurate information, and its dispensation, the following of each avenue that promises new uses for the product, and the cooperative spirit among the producers, points to an era of prosperity for these minerals.

Pioneer Stock

A LEADING metropolitan daily in a recent editorial says: "The men who are following the leads of the geologists are of the pioneer stock upon which the country and the world has always depended." Civilization in all its stages has followed the advent of the miner. Upon the broad back of this great industry rests the industrial and cultural advancement not only of the past ages, but of the present and the future.

America is rich in minerals. But the cream of her mineral resources is gone. The deposits discovered today are no longer on the surface, and are costly of recovery. Geophysics prospecting, the new scientific wonder of the age, will play a great part in the development of our future mining industry, as will the discoveries of scientists who are bending their energies to determine new methods of recovery and utilization of our low-grade and complex ores.

Fifty years ago gold and silver formed the principle products of our metal industry. Today that industry includes great developments of copper, zinc and lead, and in fact, all the known minerals. We are entering a new era now, an age of non-metallics, in which America abounds. New uses are being found for these minerals, and our resources are being developed to a state where they are an asset instead of a potential resource.

American capital should devote its first attention to the development of these, and other mineral industries of this country. The advancement of our present civilization depends in a large measure upon the wisdom and foresight of capital investment in their development.

ANNUAL MEETING *of* WESTERN DIVISION, *The* AMERICAN MINING CONGRESS

Discussions Of Economic And Practical Operating Problems Scheduled For Sixth Annual Meeting— American Institute Of Mining Engineers, And California Development Association Cooperating— Committee Announces Interesting Program

PROGRESS and Problems of the western mining industry will occupy the spotlight during the annual convention of the Western Division of the American Mining Congress, to be held at the Biltmore Hotel, Los Angeles, Calif., September 10-13. Mr. Philip Wiseman, chairman, and Mr. G. Chester Brown, secretary of the Western Division, have announced a program of major importance. Discussions will center around stabilization of production and prices of metals, the necessity for an adequate protective tariff, state and national taxation, greater efficiency in producing gold, and the practical and technical problems of the copper, gold, silver, and lead and zinc producers.

Speakers of national importance will address the meeting. The Hon. Tasker L. Oddie, United States Senator from Nevada, and chairman of the Senate Mines and Mining Committee, will talk on "The Government and the Mining Industry," and Dr. George Otis Smith, director of the United States Geological Survey and president of the American Institute of Mining and Metallurgical Engineers, will discuss "Our Share in the Nation's Business."

Cooperating with the Western Division in this convention will be the American Institute of Mining and Metallurgical Engineers, who will hold a regional conference of its western chapters, and the California Development Association. Both these organizations have arranged programs of unusual interest as announced in this issue.

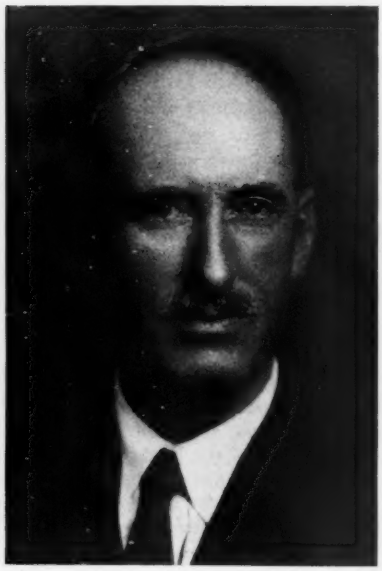
In all, there will be eight sessions of the convention, the Western Division being responsible for five of them, the Institute for two, and the California Development Association for one session. A special evening session will be held at

Philip Wiseman, California, Chairman

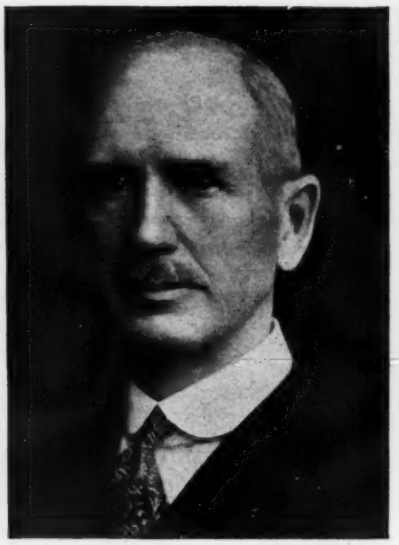
OFFICERS OF THE WESTERN DIVISION OF THE AMERICAN MINING CONGRESS

F. W. Maclennan, Arizona, Vice Chairman

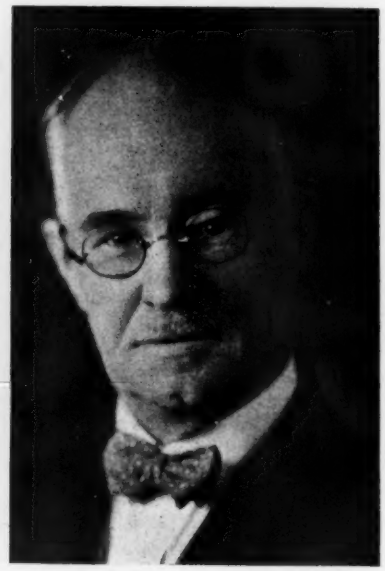
G. C. Brown, California, Secretary



W. B. Gohring
Arizona



Jesse F. McDonald
Colorado



M. B. Tomlin
Colorado

which Senator Oddie will be the principal speaker.

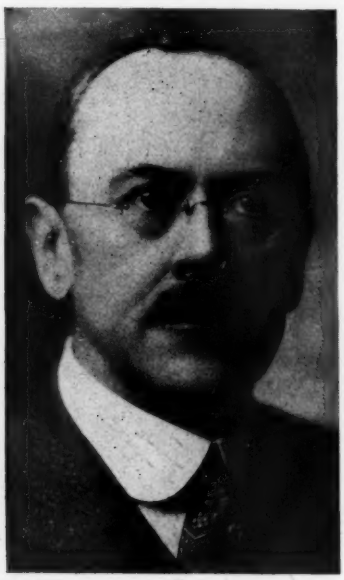
One of the interesting features of the convention will be the two sessions devoted to the discussion of practical operating problems, with papers covering phases of ore concentration and underground mine operations.

The convention will open on Monday, September 10, with Mr. Philip Wiseman, chairman of the Western Division, presiding. This session will be devoted to a general survey of "Progress in the Mining Industry," with short talks from the representatives of the various state organizations throughout the West. A special feature of this session will be an address by Charles W. Merrill on "The Needs of the Western Metal Mining Industry."

Chairmen for the various sessions, as announced in the preliminary program, include Mr. E. P. Mathewson, head of the Arizona School of Mines and past president, the American Institute of M. & M. Engineers; Guy N. Bjorge, consulting engineer and associate editor, THE MINING CONGRESS JOURNAL; Charles W. Merrill, president of Merrill Engineering Company; J. F. McDonald, president of the Downtown Mines Company and formerly chairman of the Western Division and now director of the American Mining Congress; Robert Linton, prominent mine operator, formerly a director of the American Mining Congress and the Insti-

A. P. Ramstedt
Idaho

Ravenel Macbeth
Idaho



William Daly
Montana

C. L. Berrien
Montana

J. C. Kinnear
Nevada

John M. Sully
New Mexico

tute; and Robert E. Tally, United Verde Copper Company and director, the American Mining Congress.

The personnel of the Western Division, under whose auspices the meeting is held, is as follows:

WESTERN DIVISION — THE AMERICAN MINING CONGRESS

Board of Governors

Philip Wiseman, Los Angeles, Calif., chairman of the division.

F. W. Maclennan, Miami, Ariz., vice chairman of the division.

G. Chester Brown, San Francisco, Calif., secretary of the division.

Arizona—F. W. Maclennan, Miami Copper Co., Miami; W. B. Gohring, 419 Heard Bldg., Phoenix.

California—Philip Wiseman, 1206 Pacific Mutual Bldg., Los Angeles; G. Chester Brown, Clunie Bldg., San Francisco.

Colorado—Jesse F. McDonald, Leadville; M. B. Tomblin, 437 State Office Bldg., Denver.

Idaho—A. P. Ramstedt, Wallace; Ravenel Macbeth, Overland Bldg., Boise.

Montana—Wm. B. Daly, 510 Hennessy Bldg., Butte; C. L. Berrien, Drawer 1375, Butte.

Nevada—J. C. Kinnear, McGill; Henry M. Rives, Nevada Mine Oper. Assn., Reno.

New Mexico—J. M. Sully, Chino Copper Co., Hurley; J. F. Woodbury, Silver City.

Oregon—Robert M. Betts, Cornucopia; A. W. Strowger, Northwestern Bank Bldg., Portland.

South Dakota—B. C. Yates, Homestake Mining Co., Lead; R. G. Wayland, Homestake Mining Co., Lead.

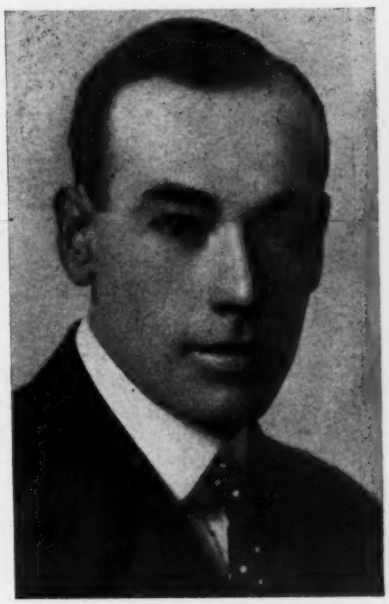
Utah—D. D. Moffat, Deseret Bank Bldg., Salt Lake City; A. G. Mackenzie, Kearns Bldg., Salt Lake City.

Washington—Frank M. Smith, Paulson Bldg., Spokane; Leon Starmont, 312 Lindelle Block, Spokane.

Local and national representatives who have been immediately responsible for the development of the program are:

Representing the American Mining Congress—J. P. Hodgson, of Arizona; Robert Linton, of California; J. W. Ady, of Colorado; C. W. Newton, of Idaho; C. S. Berrien, of Montana; J. C. Kinnear, of Nevada; R. B. Tempest, of New Mexico; A. S. Winther, of Oklahoma; Frank M. Smith, of Washington.

Joseph F. Woodbury
New Mexico



Robert M. Betts
Oregon

Bruce C. Yates
South Dakota

R. G. Wayland
South Dakota

D. D. Moffat
Utah

Representing the Institute—J. A. Carpenter, of Reno; W. F. Dietrich, of Stanford; H. S. Gale and A. B. Tucker, of Los Angeles; G. J. Young, of San Francisco; E. P. Mathewson, of Tucson.

Executive Committee—Philip Wiseman, Robert R. Boyd, C. S. Knight.

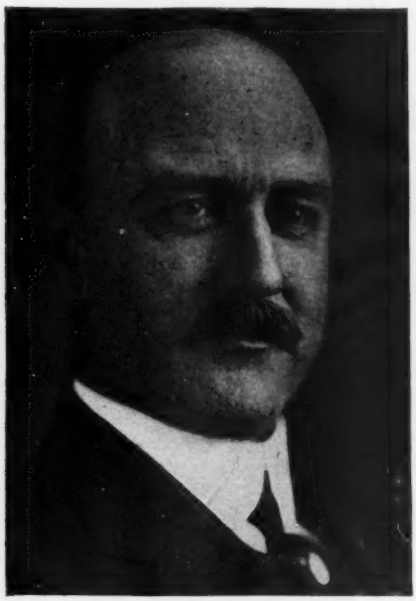
Committee Chairmen—Finance, Ward Blackman; Publicity, Edward Higgens; Program, Robert Linton.

Secretary—Guy N. Bjorge.

Mr. J. F. Callbreath, secretary of the American Mining Congress, has just completed a trip through the various mining districts of the West in connection with the meeting, and reports considerable interest and an assured attendance of several hundred operators.

A special program of entertainment is being arranged by the committee, which will include trips to various plants and points of interest near Los Angeles, as well as special golf privileges.

A special meeting of the Board of Governors will be held to elect officers for 1929 and to select the place for the 1929 meeting. A large number of western cities have extended hearty invitation to the Division to hold their meeting in their midst, among which are Spokane, San Francisco, Portland, and Seattle.



A. G. Mackenzie
Utah

Leon Starmont
Washington

Frank M. Smith
Washington

TENTATIVE PROGRAM

SIXTH ANNUAL MEETING—WESTERN DIVISION

of the

AMERICAN MINING CONGRESS

REGIONAL CONFERENCE, WESTERN CHAPTERS, AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

MINING SECTION, CALIFORNIA DEVELOPMENT ASSOCIATION

SEPTEMBER 10-13, 1928

CONVENTION HEADQUARTERS—Room 287, Los Angeles Biltmore—LOS ANGELES, CALIFORNIA

GENERAL INFORMATION

Headquarters, Registration Desk, Information Desk and Meetings—Galeria Floor, Los Angeles Biltmore Hotel.

Registration will begin at 8 a. m., Monday, September 10, 1928. All in attendance are urged to register as soon thereafter as possible.

All modifications of the program, meetings of committees, and other announcements will be posted at the information desk. Chairmen are requested to communicate their announcements to the desk promptly.

In the absence of specific local address, mail and telegrams received will be held at the information desk. If not called for before adjournment, will then be returned to senders.

Coupon tickets for such entertainment as may be provided and tickets to complimentary luncheon on Monday will be issued at time of registration.

Delegates desiring to play golf, to visit any particular plant, or to see any of the special points of interest in or near Los Angeles, will kindly report such wish to the information desk and proper provisions will be made.

PRELIMINARY PROGRAM

LOS ANGELES, CALIF.,

September 10-13, 1928

Monday, September 10, 1928

Morning Session

All sessions to be held at Biltmore Hotel.

Sessions under auspices Western Division, The American Mining Congress.

8.30 a. m.

Registration of Delegates.

PRESIDING OFFICER: *Philip Wiseman.*

Address of Welcome—

By PHILIP WISEMAN, *Chairman*, Western Division, The American Mining Congress.

Three-minute responses on the Progress of the Mining Industry:

A. G. MACKENZIE, Utah Chapter of The American Mining Congress.

J. F. MCDONALD, Colorado Chapter of The American Mining Congress.

C. L. BERRIEN, Montana Mining Association, Butte, Mont.

J. D. CONOVER, Tri-State Zinc and Lead Ore Producers' Association, Tri-State District.

G. CHESTER BROWN, California Metal and Mineral Producers' Association, California.

W. B. GOHRING, Arizona Chapter of The American Mining Congress.

FRANK M. SMITH, Idaho Mining Association, Idaho.

HENRY M. RIVES, Nevada Mine Operators' Association, Nevada.

J. F. WOODBURY, New Mexico Chapter of The American Mining Congress.

Address—

By CHAS. W. MERRILL.

"The Needs of the Western Metal Mining Industry."

Selection of Committee on Resolutions.

12.15 p. m. sharp.

Complimentary Luncheon to all Delegates. Tickets at Registration Desk.

TOASTMASTER—*Edwin Higgens, Secretary, Los Angeles Chamber of Mines and Oil.*

Two-minute responses by victims designated by the Toastmaster.

Afternoon Session

Session under auspices American Institute of Mining and Metallurgical Engineers.

2.00 p. m.

PRESIDING OFFICER—*E. P. Mathewson.*

"Why Not an Electrolytic Zinc Plant for the Southwest?"
By J. B. TENNY, Geologist, Arizona Bureau of Mines.

"High Efficiency Motor Generator Sets for Leaching Plants."
By DAVID HALL, General Engineer, Westinghouse Electric & Mfg. Company, Los Angeles.

"Natural Gas Conservation in California."
By MARTIN VAN COUVERING, Petroleum Engineer, Los Angeles.

"Comparison of Methods of Block Caving."
By CHARLES A. MITKE, Consulting Mining Engineer, Phoenix.

"Flotation."
By IRVING A. PALMER, Professor of Metallurgy, Colorado School of Mines, Golden.

Evening Session

8.00 p. m.

Special reception of delegates by local committee.

Address—

By Hon. TASKER L. ODDIE, Chairman, U. S. Senate Committee on Mines and Mining.

SUBJECT: **"THE GOVERNMENT AND THE MINING INDUSTRY."**

TUESDAY, SEPTEMBER 11, 1928

Morning Session

Session under auspices Western Division, American Mining Congress.

9.30 a. m.

PRESIDING OFFICER—*Guy N. Bjorge.*

Introduction of Resolutions.

"Underground Mine Ventilation Problems at the Copper Queen."
By J. B. PULLEN, Ventilation Engineer, Copper Queen Branch, Phelps Dodge Corporation.

"Sinking of the North Lily Shaft."
By J. S. FINLAY, Superintendent, North Lily Mining Co.

"Mining Problems at the Argonaut Mine."
By O. MCCRANEY, Superintendent Argonaut Mining Co.

"Problems Met in the Change From Open Pit to Underground Mining at the Liberty Pit."
By W. S. LARSH, Superintendent, Nevada Mines, Nevada Consolidated Copper Co.

"The Use of Scrapers in Underground Loading at the Ruth Mine."
By CHAS. F. STEINBACH, Nevada Mines, Nevada Consolidated Copper Co.

"Revisions in the Coarse Crushing and Fine Crushing Department of the Hurley Plant."
By FRED HODGES, Superintendent of Mills, Chino Mines, Nevada Consolidated Copper Co.

Afternoon Session

Session under auspices Mineral Committee, California Development Association.

2.00 p. m.

PRESIDING OFFICER—*Charles W. Merrill.*

Introduction of Resolutions.

"Mineral Development in Southern California."
By RUSH T. SILL, Vice Chairman, Mineral Committee.

"National Publicity on the Mining Industry."
By DEAN FRANK H. PROBERT, Chairman, Mineral Publicity Committee, emphasizing the importance of the Mineral Industry to Agriculture and Industry.

"Federal Legislation Affecting Mineral Development."
(a) U. S. Bureau of Mines and U. S. Geological Survey.
(b) Federal Control of High-Grade Evil.
(c) Miscellaneous.
By WILLIAM E. COLBY, Chairman, Mineral Legislation Committee, California Metal and Mineral Producers' Association.

"Coordination of Agencies in Mineral Research."
By WALTER STALDER, Vice Chairman, Mineral Research Committee.

5.00 p. m.

Meeting of the Board of Governors of the Western Division of The American Mining Congress.

WEDNESDAY, SEPTEMBER 12, 1928

Morning Session

Session under auspices Western Division, American Mining Congress.

9.30 a. m.

PRESIDING OFFICER—*J. F. McDonald.*

"The Supply Department."
By A. J. MACLEAN, General Purchasing Agent, Utah Copper Co.

"The Mine Manager's Cost Control Problem."
By T. O. MCGRATH, General Manager, Shattuck Denn Mining Corporation.

"Cooperative Mining Development."
By JAMES W. WADE, Assistant General Manager, Tintic Standard Mining Co.

"Diesel Engines as a Source of Power."
By H. H. PRATT, Chief Mechanical Engineer, Phelps Dodge Corporation.

"The Preparation and Modification of Ore Pulps in Flotation."
By H. S. MARTIN, Utah Copper Co.

"The Conditioning of Pulp in Flotation."
By A. CROWFOOT, Mill Superintendent, Morenci Branch, Phelps Dodge Corporation.

Afternoon Session

Session under auspices American Institute of Mining and Metallurgical Engineers.

2.00 p. m.

PRESIDING OFFICER—*Robert Linton.*

Address—

"Our Share in the Nation's Business."
By GEORGE OTIS SMITH, President, A. I. M. M. E.

"Possibilities of Non-Metallic Mineral Development in the Pacific States."
By GEORGE J. YOUNG, Associate Editor, Engineering and Mining Journal, San Francisco.

"General Occurrence of Non-Metallic Minerals Throughout the State of California."
By WALTER W. BRADLEY, State Mineralogist, San Francisco.

"Some Properties of Oil-Bleaching Clays."
By C. W. DAVIS, Engineer, Bureau of Mines, Reno.

"Tripoli, Its Occurrence and Use."
By P. B. BUTLER, Mining Engineer, Barnsdall Corporation, Joplin, Mo.

"Clay Mining Methods in California."
By W. F. DIETRICH, Associate Professor of Mining Engineering, Stanford University, Palo Alto.

THURSDAY, SEPTEMBER 13, 1928

Morning Session

Session under auspices Western Division, American Mining Congress.

9.30 a. m.

PRESIDING OFFICER—*Robert E. Tally.*

Open Discussion of Problems of—

(a) Mineral Tariff.
(b) Federal and State Taxation of Mines.
(c) The Need of Revision of Mining Laws to Meet the Requirements of Geophysic Prospecting.
(d) The Stabilization of Mining Production to Prevent the Wastes of Over-Production.
(e) The Western Division of The American Mining Congress.

(Speakers limited to five minutes.)

Final: Report of Resolutions Committee.

Adjournment.

IMPROVED MARKETING FACILITIES *for* COPPER

By T. WOLFSON *

U. S. Bureau of Mines

Anaconda Hill

IN reviewing the copper industry for the year 1927 one can not help but be impressed by the great progress made in raising the standard of marketing the metal. In marketing any basic commodity the old law of supply and demand still holds sway. There are, however, two other important factors which are essential for the proper marketing of any important commodity, namely, accurate information, and creating or fostering demand.

Copper enjoying a world market, it is just as essential for the industry to have most accurate information in the principal consuming countries outside of the United States as it is within the states. Prior to the formation of Copper Exporters, Inc., the producers depended entirely on their European agents for information about the markets in Europe, each one acting independently. Such information the agents had to obtain from the buyers or their representatives and was not always accurate, being often colored by the anxiety of each buyer to obtain the material at as low price as possible. This has led frequently to fluctuations in price contrary to actual conditions. Since the formation of Copper Exporters, Inc.—October, 1926—steps have been taken to obtain reliable information as to the state of the industry in the principal consuming centers of Europe, which has greatly benefited the industry as a whole.

Strange to say, whilst we were obtaining accurate information on conditions in Europe, such was not the case on this side. The only correct data that we had to rely on was that furnished by the American Bureau of Metal Statistics, which publishes productions, stocks and deliveries once a month. To complete the picture it was felt that some source of more frequent and accurate information should be had in the largest consuming country in the world, namely, the United States, and hence the Copper Institute was formed in the fall of 1927. It is the business of the Institute to gather and distribute to members such detailed statistics as will enable the producers, in conjunction with the knowledge from the export trade, to form a fairly accurate judgment of market conditions.

The other important factor, namely, creating and fostering demand, has been taken up by an association formed here several years ago called the Copper and Brass Research Association, which includes in its membership both producers and fabricators of copper and its alloys. It is the business of this association by judicious advertising to keep before the public the peculiar merits of the metal and all the uses to which it can be put. The consumption of the metal in the United States has more than doubled in the last decade and a large part of that increase in its consumption is doubtless due to the well directed efforts of this association, supplemented by individual advertising by the large fabricators. European fabricators of copper have not been slow in recognizing the value of this service and similar associations have since been formed in Germany, France and England. Even in Scandinavia, where I have recently visited, they are thinking of forming such an association.

The result of all this has been to raise the marketing of copper to a higher plane than ever before in its history.

It is not my intention to burden this article with many statistical figures but it may not be amiss to point out a few of the outstanding facts bearing on the future of the industry.

The copper consumption of the United States and Europe for the year 1913 as given by the American Bureau of Metal Statistics was as follows:

United States..362,125 metric tons
Europe .....645,000 metric tons

This compares with the year 1927, quoting from the same authority, as follows:

United States..748,600 metric tons
Europe .....743,300 metric tons

This is very significant, showing that whereas the United States was gaining at the normal rate of increase, the European countries, because of disturbance due to the war, were standing still. In fact, the previous year—1926—the European consumption was only 623,100 metric tons, showing that the year 1927 marked the beginning of an improvement and we have every reason to believe that Europe is now on the road to resume its former relative position as a consumer of copper. In the United States the consumption in 1927 of 748,600 metric tons compares with 820,300 metric tons in 1926, or a falling off of about 72,000 metric tons.

That there was a slight recession of business in 1927 from the peak of 1926, there is no doubt, but the bulk of the falling off in consumption is accounted for by a read- (*Continued on page* 733)

In The Marketing Of Any Material, Law Of Supply And Demand Holds Sway, But May Be Assisted Through Utilization Of Accurate Information And By Creating Or Fostering Demand—Copper Has Made Great Progress In Solving Marketing Problems—Expansion Of Electrical Industry, And Development Of Water Power Requiring Large Volume Of Copper For Transmission Lines, Indicate That Prosperity Of The Industry Is Well Assured

* President, Metals Sale Corporation, New York City.

MARKETING

of SILVER

By HAMILTON M. BRUSH*

London, Calcutta and Shanghai are three of the great foreign market places for silver. Top—Royal Exchange, London. Center—Royal Exchange Place, Calcutta. Below—The Bund, Shanghai

Underwood & Underwood Photographs

SILVER, as well as gold, is not only a commodity, but is used also as currency and as reserve for currency; but silver, unlike gold, has no fixed monetary value in the principal industrial and financial nations of the world. Its marketing problems, therefore, are intimately associated with governmental regulations, trade balances, industrial activities and speculation in every part of the world, but principally in China, India, England and the United States.

The shrewdest bankers and speculators of both the Orient and the Occident have been endeavoring for centuries to forecast the silver market correctly, but no sooner has every reasonable indication pointed to a given end than an entirely unforeseen event has occurred to upset all calculations. The event may be war in China, famine in India, large speculative operations, purchases by some government for coinage, changes, actual or threatened, in government finance, or a dozen and one other happenings. For this reason it takes a brave man to speculate in silver, and, so far as I know, practically all of the producers of silver, whether miners or refiners, have for many years past made it a practice to sell their silver currently from day to day and from week to week at the ruling market prices. Under very exceptional circumstances only do these producers take any position in the market, and it would be my opinion that when they have done so they have guessed right about half the time and wrong the other half.

With the improvement in the cable service to all parts of the world, a seller in New York knows from hour to hour the going price of silver in London, Bombay, Shanghai, San Francisco and New York. A good salesman is one who keeps himself thoroughly posted as to these prices and gets the last sixteenth of a cent per ounce by selling his silver each day in the best market.

To do this it is necessary to secure and maintain good connections with good cable service, and to be possessed of a nimble brain to figure from moment to moment the parities as between various centers. This latter is no easy matter when one realizes that silver is quoted in pence per ounce 92.5 percent fine in London, in rupees and annas per 100 tolas in Bombay, in taels in Shanghai and in cents per ounce 99.9 percent fine in New York and San Francisco, with the various exchanges constantly fluctuating and with freight insurance and interest between the centers most vital factors.

The business of selling silver, as I have outlined it on the part of the producers of actual silver metal, is comparatively simple, but when newly mined silver has been sold in this manner into any one of the world's markets, it finds its way into a huge complicated machine, and that identical silver may be again sold or hedged against hundreds of times in years to come, for silver, unlike a usual commodity, is not consumed in any large way, but becomes a part of the world's treasure and is, therefore, either directly or indirectly horded with the expectation that at some future day it will be valuable and may be sold or exchanged for something else which at that time will be wanted more than the silver.

*Vice President, American Smelting & Refining Company.

Practically all refined silver finally reaches the following markets:

(1) Bombay and Calcutta, from which centers silver in substantial amounts is shipped up-country into India to satisfy the needs of the Indian population for treasure and trinkets; also in times past, from these centers the Indian Government drew their supplies for coinage into rupees, and although there has been an excess stock of rupees for the last 10 years, and no new rupee silver has been needed, there is little doubt but that in years to come this demand will reassert itself.

(2) Shanghai—the great speculative market and the one from which is drawn supplies for the silver currency of China.

(3) Practically every government in the world for the minting of major and minor currency.

(4) Commodity markets all over the world where silver is used in the arts, industries and sciences.

The main markets in which silver is sold are: (1) Shanghai, (2) Bombay and Calcutta, (3) London, (4) New York.

Conditions of sale are quite different in the four markets and may be described briefly as follows:

(1) *Shanghai:* The Chinese are born speculators and will gamble in anything from Mah Jong to commodities and foreign exchange. A typical Chinese would rather gamble than eat. As they have no stock exchange to compare with the exchanges of the Occidental nations they substitute in a large measure for stock speculation, speculation in various foreign exchanges and in silver. They not only buy and sell silver outright, but, to even a greater extent, use silver as a hedge against their speculation in gold currencies which are fluctuating. Since the stabilization of most of the European exchanges they have concentrated on yen speculation, arbitraging between Chinese taels and Japanese yen, first buying yen with taels, then reversing the operation, selling yen for taels.

Sometimes silver in Shanghai, which is the principal reserve center of China, is shipped to other markets because of arbitrage transactions, but generally it finds its ultimate disposition either in "sycee" which are small silver bars shaped like a shoe, and which after weighing and assaying are used as silver reserves, or it goes into one of the numerous silver coins of China which form the basis for their currency. The minimum fineness constituting a good delivery in this market is 99.8 percent.

(2) *Bombay and Calcutta:* Here the trading in silver is more nearly like the trading in wheat or corn in the United States, except that silver is bought and sold for delivery in approximate monthly periods and settlements are only made at the end of each settlement period.

One of the great games of the Indian speculator is to corner a settlement. When this is successful, premiums of from ½ cent an ounce to 2 or 3 cents an ounce, are sometimes exacted by the successful speculator against those who have sold for a delivery which they are unable to effect. Force majeure is not recognized in these contracts, so that a delay to a steamer carrying a large quantity of silver to Bombay may have a serious effect on those who have sold for delivery based on the expected arrival of the steamer.

Marketing Problems Of Silver Are Intimately Associated With Government Regulation, Trade Balances, Industrial Activities And Speculation In Every Part Of The World—A Review Of The Present Market Situation For This Metal, Which Is Subject To Change Without Warning.

Hamilton M. Brush

Most of the silver in India is bought through London banks, but, more recently, a considerable quantity has been bought direct from New York bankers, brokers and producers. Recently small quantities have been bought from their own government which operates an electrolytic refinery working on their stock of excess rupees and converting the resultant product from the currency composition to commercial refined metal.

As in the case of Shanghai, silver is sometimes shipped out of the Indian market against arbitrage transactions, or to create an artificial squeeze in their market, but generally it finds its way up-country, there to be horded or made into bangles. These so-called up-country shipments range from 50,000 to 250,000 ounces per day, being arranged by the Indian bazaars which buy 1,000 ounce bars and cut them up into required shapes and sizes for retail sale.

Shipments are larger during prosperous times than during bad times for obvious reasons, and as the prosperity of India depends largely upon the crops, this explains the great interest which the silver trade always has in the progress of monsoons or rainy seasons. With good rains the crops are good and the silver off-take is good; with poor rains crops are poor and the people are able to buy much less silver.

It is a remarkable fact that this steady absorption of silver has been going on for hundreds of years; it goes up-country and there it stays. The quantity of silver horded throughout the interior of India is of such vast and indeterminate volume that it could form the basis for many an Arabian Night dream.

The minimum fineness constituting a good delivery in this market is 99.6 percent.

(3) *London:* Before the war London was the great silver market of the world because of the concentration there of world banking, and particularly eastern banking, and because of their unrivaled steamship service to the Orient. Practically every ounce of silver produced in the world outside of the territory directly tributary to the Orient, such as Australia and the west coast of the United States, found its way to London, there to be stored, financed and re-shipped to the proper destination.

Four firms of bullion brokers, all of them of unquestioned integrity and standing, and one of them even antedating the Bank of England in its founding, meet daily, and after considering the advices from every part of the world interested in silver, fix the socalled London official price for prompt delivery and for two months delivery. "Best" orders cabled to London before the "fixing" to be executed on either the buying or selling side at the market are sure of being executed at the fixed price. If limits are set, the orders are executed only if the market warrants. This is one of the silver quotations to which the whole world looks for guidance, and many ore contracts are based, so far as their silver contents are concerned, on this official price. The meeting takes place every day, except Saturday, at 2 o'clock London time. On Saturday the meeting is at 11 o'clock.

There has been criticism from time to time of the prices fixed by these four firms. The phrase "price-fixing" which is commonly used, is probably a very unfortunate one from this standpoint; it seems to signify that these four firms in secret conclave fix the price of silver from day to day to suit themselves and according to their whims. This, I am convinced, is not the case, first, because of the well-deserved reputation which these firms have for strict integrity; second, because a fictitious quotation would not have been accepted by the

world at large for the last half century, and, third, because of the more personal experience of my company, viz, that we have never, to my knowledge, sent to any of the London brokers either a buying or selling order to be executed at "best" which has not been executed at the "fixed" price. This would indicate rather conclusively that a real market exists at the fixed price; this is not to say that 5 minutes before or 5 minutes after the "fixing" silver can be bought or sold at the given price, because in London, as in New York, the silver price may fluctuate from hour to hour during the entire day and the fixed price is that ruling only at the time of the meeting.

It has been estimated that the buying and selling of exchange silver or paper silver in the London market is 15 to 20 times as great in volume as the purchase or sale of actual refined metal. This makes for a constant free market with volume so that those who want to sell their actual silver, or who want to hedge against ore contracts or exchange commitments, have a free market for both spot and forward silver in which to operate.

The minimum fineness constituting a good delivery in this market is 99.6 percent.

(4) *New York:* Before the war New York sellers of silver relied almost entirely on London; sales were made here to the silverware and jewelry trade and to the United States and Canadian mints, but practically all other sales (except against silver produced on the Pacific coast), were made through London and the silver was shipped to London, there to be transshipped to its final destination. During the war years, and more particularly after the war years, there has been such an improvement in shipping service from New York direct to India, and such a stupendous advance in the size and complexity of American banking interests, that New York has developed into a most important market.

In speaking of New York I also include San Francisco as most of the San Francisco silver is sold in New York for shipment from San Francisco to China.

The New York market is an open one, prices fluctuating throughout the day according to supply and demand. The New York "official price" is that published by Messrs. Handy & Harman, and represents the daily silver market after market conditions have been determined by cable advices from foreign centers and from the various local buyers and sellers. It is issued usually at about 11.30 a. m., although delay occurs at times when the market is slow in developing. This official quotation has been used in most refining contracts in the United States and in Mexico for over 50 years, and its almost universal acceptance is a tribute to the wisdom and integrity of this old firm.

Sales in New York are made for any delivery from spot, or immediate delivery, up to six months, these sales for forward deliveries being usually made, not for a fixed date, but for delivery at seller's option in the month stated, either for the first or the second half, but mostly for delivery during the entire month. Banks in New York operating in silver are continually exchanging one delivery for another, San Francisco, New York, London, Bombay or Shanghai, and spot against forward, or vice versa. This practice, called by the British "budlee" business, and known to us as "swapping," is of considerable importance to the silver producers, who may not be able to meet the demand for a specific delivery, but may often supply silver which may be used by the banks in exchange for the desired delivery. To that extent, the trading American banks have been of considerable assistance in establishing New York as an important market for silver.

As a further illustration of the helpful effect upon the New York market, these New York banks, by operating in Far Eastern exchange, use silver as a "hedge" against their purchases or sales of yen, Hongkong dollars, taels and rupees. The banks also operate in the purchase and sale of silver as bullion, but the use of silver in connection with Far Eastern exchanges is much greater than the use of silver as a commodity. The sale of Hongkong dollars by a bank may be covered by the purchase of silver in this market, which is shipped to Shanghai for conversion into sycee, giving the bank credit in Shanghai in the shape of taels, with which Hongkong dollars are then purchased in Shanghai. The silver not being available at a proper price, the bank, instead of purchasing silver in New York, might sell yen in Shanghai, receiving taels in exchange. The trader would then await a proper opportunity to cover the sale of yen, so that funds would be available in Japan prior to the date when they were needed to meet the drafts covering the sale in Shanghai. On the other hand, should the bank sell yen in this market, thereby receiving dollars, silver might be purchased here for shipment to Shanghai for conversion into taels and used to cover the purchase of yen in Shanghai. The complexity of exchange operations is bewildering, and it is a tribute to American bankers that this highly complicated arbitrage business, which is comparatively new to American banking circles, has been mastered to such an extent that a great deal of the business which has heretofore been handled by London is now being transacted through this market, and by reason thereof has, to a great extent, stimulated and broadened the market for silver in New York.

Silver for trading purposes or foreign shipment is sold in New York generally in units of 50,000 ounces with a guaranteed minimum fineness of 99.9 percent, although purchases for account of the arts and industries are often made in smaller amounts.

The arts and industries consume over 30,000,000 ounces silver annually in the United States; how much more in other parts of the world I do not know, but the amount is considerable. The principal uses are sterling ware, plated ware, films and many minor uses such as automotive contact points, silver solder and silver nitrate. The buying by governments for coinage purposes is done in a great variety of ways. The United States Mint always asks for tenders of specific quantities, sealed bids to be in their hands by a certain time and the lowest bid is accepted. Foreign governments sometimes buy direct, but more generally through confidential bankers or brokers, and most of this business is handled through London.

It is very encouraging to see that with the stabilization of the French franc the Government has decided to coin silver 5 and 10 franc pieces for general circulation. This brings all of the great governments of the world back into the silver column and gives another indication of the appeal which silver has for the great masses of people all over the world. Somehow a man feels safer and more respectable when he is jingling silver coins in his pocket rather than base metal tokens or dirty little scraps of paper.

Although this article is much longer than I had intended to make it, it seems, on completion, as though only the surface of the silver market had been scratched. It is by no means written for those who have made a study of the subject, as it tells them nothing new, but to go into the matter with a view to interesting such people would require the writing of a book rather than an article.

Reporting on its supervision of mining leases on public lands, the Geological Survey says:

"There are twenty stations from which petroleum and mining engineers supervise the development. Conservation of mineral resources, and maximum ultimate recovery of mineral deposits under safe mining and producing conditions are their goal. The system of regular periodic mine inspection is a source of suggestions for better mining and milling practices that lead to more complete production at reduced cost and tend toward better working conditions and increased safety for employes."

PROMOTION *of* SAFETY *at the* RAY PLANT NEVADA CONSOLIDATED COPPER CO.

By MOSES BROWN*

Ray plant in vicinity of No. 1 shaft. In foreground dormitories, tennis courts and dance platform and club house. In the background hoist No. 1, main shaft, crusher and No. 1 bin, assay office and candle house—caving ground behind the latter

From the very start of operations at the plant of the Ray Consolidated Copper Company, now the Arizona Division of the Nevada Consolidated Copper Company, the management has given particular attention to all matters pertaining to the safeguarding of its employes from the hazards of their trade. In 1914 it was realized that, to successfully carry out this policy, it would be necessary to employ a specially trained man who could give all of his time and thought to the promotion of safety. That first safety engineer has had but three successors down to the present day, a period of nearly 15 years. Each in his turn has justified his long tenure of the position by progressive improvements everywhere about the plant, and today no department is considered more vital to the successful operation of the mines than the safety department.

Whatever may be the actual ratio which preventable accidents bear to those which are apparently unavoidable, it is obvious that many of the accidental deaths and losses of sight or limbs could have been prevented if some one had been more careful, or if some one had done the right thing at the right time. It is for this reason that the matter of safety education, the unremitting spread of safety propaganda among the workers themselves, is recognized as the most important of the activities of the safety engineer at Ray. Some of the high points in this constantly waged campaign against ignorance, indifference and carelessness are briefly outlined in the following paragraphs.

An Outline Of Some Of The Things This Company Has Done In Their Effort To Minimize Risks And Eliminate Accidents—Full Time Safety Engineer Is Employed; Definite Rules Are Promulgated And Failure To Adhere To Them Means Discharge—Each Succeeding Year Has Shown Distinct Progress And Improved Safety Conditions

First of all comes the ruthless weeding out of careless men—Ray has no place for them. Then there are men who, however good their intentions may be, are found to be absolutely devoid of normal alertness of mind — their occupation should be elsewhere than in a mine. Of equal importance to the elimination of such undesirables is the effect of this procedure on their former fellow workmen.

The basis of the safety movement is the safety rules or, as they are designated locally, "operating regulations." At the main entry, where the mine crews enter and leave the mine, there is maintained an attractive booth, on one side of which the operating regulations are printed in English, and, on the other side, in Spanish. These regulations are not numerous, but each one is specific in that it instructs some particular class of labor, such as miner, chute blaster, or trainman, relative to the safe operating methods which he must follow in the performance of his duties. Similar displays of appropriate regulations are to be found in other parts of the plant, as well as bulletin boards, on which are posted from time to time new or special instructions which may later on become permanent regulations. It is not possible to make sure that every employe reads these rules, but summary action in the case of willful or careless disregard of these rules provides the incentive for most of the men to learn the rules in some way.

As a follow-up program in connection with the operating regulations, the safety engineer holds occasional meetings with the employes, at which time he discusses with them the matter of safe and unsafe methods of doing their work and invites suggestions and criticism from the men themselves. While any interested man is welcome at each meeting, it is aimed to bring out some special group of men; for instance, machinemen and timbermen, chute blasters and tappers, motormen and brakemen. At such times the discussion centers on the problems of the particular group attending. These meetings have been very well attended, the men are interested, and the discussions are surely productive of good results.

Each month a "safety luncheon" is

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held at which the mine officials, department heads, foremen, and bosses, both underground and surface, are present. At these luncheons recent accidents are described and discussed, as well as operating conditions in general, and any condition or procedure which anyone considers at all unsafe. Such topics are thoroughly discussed, and where the discussion brings forth suggestions or procedures which promise safer conditions, they are immediately put into effect. Several of the suggestions made at these luncheons have been far reaching in their effect on the betterment of safety conditions. The making of suggestions is, however, not limited to those who are present at these luncheons, for the management encourages all members of the organization to make safety suggestions and for all suggestions which are accepted suitable awards are made.

The personal work of the safety engineer is, without doubt, the most effective factor in spreading from the highest to the lowest the fundamentals of safety and accident prevention. Frequent trips through the underground workings, the mills, and the shops, and tactful personal contacts with men, whose positions range from department head to mucker, keep the safety thought alive. Each week, through the medium of his "safety letter," he brings up-to-date local safety news to the attention of all interested, and works to inspire a wholesome rivalry among the bosses in the matter of accident prevention. In any campaign, whether it be educational or otherwise, the constant follow-up is the thing that gets results.

Accurate records are kept of the performance of each division boss and jigger boss relative to the number of accidents per man shift worked, and the number of man shifts worked per shift lost on account of accidents. For the best records graduated monetary awards are made each month, and similar and larger awards are made at the end of the year.

A recent innovation, proposed at one of the safety luncheons, is a flag pole on which are four flags, each of a different color, and each representing one of the four different groups of employes into which the plant crew is divided for this purpose. The white flag represents the general surface department, the blue the mechanical department, while a red and a green are the colors of two groups in the mining department. At the first of each month all flags fly at the top of the pole, but as soon as one group has an accident its flag is moved to a point below the others. When the flags are strung out one above the other, the lowest flag signifies that the group it represents has had the least number of shifts worked per accident. Keen interest is taken by all employes in this record.

First-aid courses are given at frequent intervals, and the men are encouraged to repeat the work in order to keep it fresh in their minds. From the underground department a number of first-aid teams are trained for a contest, which is held each year on the 16th of September, and at which generous cash prizes are given to the teams winning first, second, and third places. It is safe to say that one man out of every three on the pay roll is competent to administer first aid.

Strict attention is paid to maintaining suitable first-aid equipment and supplies at all important working centers on the property, both on the surface and underground. Each section in the mine has a first-aid station, in which are kept splints, stretchers, blankets, and complete sets of smaller supplies. Particular care is taken to keep these stations as clean and attractive as possible. There is one first-aid station to every 40 men.

Artificial ventilation is provided for the mine by three large exhaust fans on the surface, and little or no trouble with gaseous conditions is experienced throughout the workings. Wherever there is occasion to suspect bad air in a stope a sample of the air is taken and analyzed with an Oresat apparatus, which is kept readily accessible at all times.

All shafts leading into the mine are concreted, and all those which could be used as exits in case of fire are downcast. Centrally located on each main level there is a truck fully equipped with fire extinguishers, hose, and other fire-fiighting equipment. At frequent intervals along the drifts there are fire hydrants and water hose, and, at each ventilation door, there is kept bulkhead material for making the door absolutely air-tight should this become necessary.

Maps of the workings, which show the direction of the various air currents, are kept up to date, so that in case of a fire the probable course of the gases can be quickly determined. These maps also show the location of all the emergency exits. In the mine each emergency exit is marked by a green light and a sign which tells the working with which it communicates.

The procedure in case of fire in the mine has been carefully worked out and agreed upon, so that each operating official knows just what he has to do as soon as he is advised of a fire. Upon discovery of a fire the first alarm is turned in to the telephone central office. The telephone operator has in front of her a bulletin showing the order in which the various operating officials are to be advised. The order is made in accordance with the various duties of the officials. The operating mine foreman on shift is notified first, so that he can spread the alarm underground and start getting out the men. Next the mine superintendent is advised, and then, in the following order, the safety engineer, captains of the mine rescue teams, members of the teams, general mine foreman, garage foreman, medical staff, master mechanic, chief electrician, etc.

There are four mine rescue teams always in training. At the present time there are 31 men at the plant who have qualified as experts in mine rescue work. Each team practices once a month in smoke in the fire tunnel and one day each month on overhauling and inspecting equipment. For serving on the team each team member receives a bonus in addition to his regular salary, the captains of the team receiving a slightly larger amount than the men. The fire station is equipped with 12 Paul self-contained breathing apparatus, and six ½-hour McCaa machines, together with all other necessary equipment, such as brattice material, life lines, flash lights, tools and emergency telephones.

It would unduly prolong this article to describe in detail all of the protective measures which are in practice at the Ray plant. The compulsory wearing of "hard-boiled" hats by all men working underground; the wearing of goggles by everyone whose work exposes him to danger of eye injury; the use of respirators by all who are exposed to dust conditions; the wearing of leggings by brakemen; the increasing use of hard-toed safety shoes; these are but a few examples of many aids to safety which are daily giving proof of their effectiveness at Ray.

ACCIDENT-PREVENTION WORK OF MIDWEST REFINING COMPANY

AN Information Circular of the Bureau of Mines (Number 6064), by E. H. Denny of the Bureau's staff, gives some interesting details of the accident prevention work of the Midwest Refining Company.

As the result of the work of its efficient safety organization, the company at its various operations and particularly in the Salt Creek, Wyoming, oil field, has been able to show a definite reduction in the number of accidents occurring among its employes, according to the Bureau. It is estimated roughly that accidents in 1924 cost the company $200,000; in 1925, $150,000; in 1926, $82,000, and in 1927, but $25,000.

The accident-prevention work of the company is in charge of the department of industrial relations, with a director as the administrative head; two safety men handle the work directly at Midwest, Wyo. A competent medical staff with a well-equipped hospital at Midwest is also an important factor in the prompt and proper treatment of injured persons.

The NEW INCOME TAX LAW

By WALTER A. STAUB*

The Recently Enacted Revenue Act Of 1928 Effected A Number Of Changes In The Federal Income Tax, (1) In Rates Of Tax, (2) In Method Of Determining Taxable Income, And (3) In Administrative Features Of The Law—This Article Does Not Attempt To Enumerate All The Changes Effected By The New Law, Or To Deal Comprehensively With Them, But Directs Attention To Some Of The More Important Changes

RATES OF TAX

THE principal beneficiaries of reduced income taxation are corporate taxpayers. The Treasury had recommended, and the Senate had given it effect, that surtax rates applicable to incomes between $20,000 and $80,000 be reduced. It was felt that the rates advanced too rapidly in these brackets, especially when it is remembered that the maximum rate of 20 percent is reached with $100,000, and there is no advance in rate beyond that point no matter how large the year's income. The House, however, was opposed to the Treasury recommendation, and in conference the Senate action was withdrawn, so that the rates for individuals are the same as under the 1926 act.

Despite the vigorous campaign by the United States Chamber of Commerce for a more drastic reduction, the conservative view of the Treasury prevailed. The corporation rate was finally fixed at 12 percent instead of the former rate of 13½ percent. While this can hardly be deemed drastic reduction, it is nevertheless material.

It is to be hoped that in spite of the pessimism expressed in some quarters as to its feasibility further reduction will be effected in the near future. The obligation to pay over to the Federal Government almost one-eighth of the year's net income—being, as it is, in addition to the large amount of local and state taxation—is certainly a burden on business. The aforementioned Treasury recommendation with respect to incomes between $20,000 and $80,000 likewise should, in the interest of equity, be given effect.

The House had proposed a graduated tax on small corporations, the maximum rate being 9 percent, if taxable income did not exceed $15,000. This compared with the rate of 11½ percent proposed by the House for all other corporations. The graduated tax was eliminated by the conference committee of the House and Senate, so that all corporations pay the same rate no matter how large or small their incomes, subject only to the $3,000 exemption granted corporations whose net income does not exceed $25,000. This exemption was only $2,000 in the 1926 act.

The new rate of 12 percent is not retroactive to January 1, 1927, as originally intended, but is effective only from January 1, 1928. Calendar year corporations will, therefore, experience the benefit thereof for the first time in 1929 when paying the tax on their 1928 income.

DETERMINATION OF TAXABLE INCOME

Little change was made in the definition or classification of either the gross income or the deductions therefrom which enter into the determination of the taxable net income of most businesses. Some of the changes made affect special groups of taxpayers. Mention may be made of the following:

Banker's acceptances—Income derived by foreign central banks of issue from banker's acceptances is no longer to be treated as income from within the United States. This was done to aid the development of a dollar acceptance market. (Section 119 A-1-C.)

Instalment sales—The provisions of the 1926 act applicable to the determination of the taxable income derived from business on the instalment plan are continued for the future, excepting that the initial payment on casual sales or instalment sales of realty may now be 40 percent without taking the sales out of the instalment class. An attempt has been made to meet the charge that, as to earlier years especially, an injustice was done in taxing the same income on both the accrual and instalment basis, when the regulations in force at the time provided only for taxation of the same sales on only one basis or the other. The double taxation resulted from a decision of the Board of Tax Appeals in *Blums, Inc.*, and caused the Treasury to change radically its previous regulations. The 1928 act provides that no deficiency shall be collected on the double taxation rule in the case of returns filed on the instalment basis prior to the passage of the 1926 act for 1924 or prior years. Rather inconsistently, however, the act also provides that no refund shall be made unless under the double taxation theory the tax was actually overpaid. (Section 705.) Provision is also made for taxing instalment obligations which are distributed or otherwise disposed of under conditions that might have permitted of the tax being avoided under previous laws. (Section 44-d.)

Walter A. Staub

Basis for determining gain or loss—The enumeration of the adjustments to be made of the original cost or other "basis" of property sold or otherwise disposed of during the taxable year is amplified. Also, it is provided that the basis of stock shall be diminished by prior distributions on such stock to the extent provided by the law applicable to the year in which such distributions were made. (Section 111-b.)

Transfers in contemplation of death—The existing provision of law that

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property represented by gifts and transfers in trust inter vivos after December 31, 1920, shall upon sale or other disposition have the same basis as it had in the hands of the last previous owner for value, has been extended to embrace all transfers in trust (not by a bequest or devise) made after December 31, 1920, even if made in contemplation of or to effect in possession or enjoyment at or after death. (Section 113-a-3.)

Basis of estate or heir's property—Because of conflicting court and Board of Tax Appeals decisions, doubt had arisen as to the basis to be used in determining gain or loss on the disposition of property by an executor or legatee. The crux of the question was as to the date as of which basic value should be determined. Should it be at date of purchase or other acquisition by the deceased owner, at the date of his death or (in the case of a legatee) the date at which formal transfer was made to him by executor or other administration?

The 1928 act (Section 113-a-5) provides that in the case of a specific bequest of personal property or of real property transmitted under interstate laws the basis shall be the value at time of the owner's decease, the theory being that the ownership vests immediately in the beneficiary. This rule is also applied to property sold by the executor or other administrator of the decedent's estate.

In all other cases than the above the act provides that the value at date of actual distribution to the devisee governs.

The 1926 law was amended (Section 702) to validate, at the option of the taxpayer, any return filed by an estate for a year prior to 1928 in which the gain or loss was computed either on the basis of the value of the property at the time of the death of the decedent or in accordance with regulations existing when the return was filed. If a taxpayer claims a different basis, the matter is left open for judicial determination within the statutory period of limitation.

Basis in reorganization—Under the earlier of the series of Federal income tax laws, beginning with that of 1913, a taxable gain was deemed to have been realized in many cases in which there had not been an actual realization but merely a change in form of the taxpayer's investment. For example, the General Motors Corporation was originally incorporated in New Jersey and had outstanding $15,000,000 of 7 percent preferred stock and $15,000,000 of common stock, all of a par value of $100 per share. In 1916 it was reincorporated in Delaware and each holder of a $100 share of common stock received five shares of the common stock (par $100 each) of the new corporation and each holder of a $100 share of preferred stock received one and one-third shares of 6 percent preferred stock (par $100 each). Until he sold his new shares a common stockholder had not actually realized any profit, because he still had no greater proportionate interest in the property and profits of the General Motors Corporation than prior to the reorganization; nevertheless it was held by the United States Supreme Court in *Marr* v. *U. S.* (263 U. S. 536) that a gain had been realized by stockholders at the time of the reorganization to the extent that the value of the new shares at the time of reorganization exceeded the cost (or value at March 1, 1913, if acquired prior thereto) of the old shares.

It became increasingly recognized that a mere change in the form of an investment did not constitute actual realization of a profit which should be taxed, and the 1918 act contained a provision for suspending the tax in certain types of reorganization. The 1921 act went further and the 1924 act still further, the reorganization and exchange provisions of the last named being substantially those in the 1926 and 1928 acts.

Under the provisions of the 1921 act, however, it was possible to "step up" property values so as to secure a higher basis for depletion and depreciation allowances, or for determination of the profit in the event of sale, even though there was no change in interest and the stockholders were relieved of any tax on the increase in basis effected by the corporate reorganization. The 1924 act made some changes in the reorganization provisions, so as to prevent this "stepping up" process, and provided in effect that where there was no substantial change in interest and the reorganization or incorporation was deemed to be a continuing transaction, the basic value of the corporate property for depletion and depreciation purposes and for subsequent sale or other disposition should likewise be deemed to remain unchanged.

In the 1928 act a further step is taken to prevent a "stepping up" in certain types of reorganization in which it was apparently still possible. Paragraphs (7) and (8) of subsection 113 (a) of the 1928 act now provide clearly that the transferor's basis shall carry forward to the transferee, adjusted for any taxable gain or deductible loss recognized at the time of the transfer. This change was first made retroactive to past transactions, but it was finally decided to make it apply only to transactions after January 1, 1928.

Intercompany property transactions—For the first time the action in Section 113 (a-12) makes reference to the basis for determining gain or loss, if any, on property passing between affiliated companies. The basis is not actually prescribed, but the commissioner is given power to prescribe rules under which any gain or loss is to be recognized, including any adjustments for depletion and depreciation. For the purposes of this section, companies will not be regarded as affiliated for any year after 1921 (since affiliated companies have had the option of filing either consolidated or separate returns), unless they filed a consolidated return for such year.

Depletion and depreciation—The principle on which these allowances are to be deducted from gross income has not been changed from the 1926 act. In general, Sections 113 and 114 provide that these allowances are to be based on (a) cost of the property if acquired after March 1, 1913, or (b) cost or March 1, 1913, value of the property, which ever is higher, if acquired prior to that date. In the case of mines, depletion is also allowed on the value of ore deposits discovered by the taxpayer after February 28, 1913, if not known at time of purchase of the mine or included in previous valuation; this allowance may not exceed 50 percent of the net income (before depletion) from such deposits. In the case of oil wells taxpayers have the option of taking in lieu of the above deductions (a) or (b) a depletion deduction at the rate of 27½ percent of the gross income from the property. Reference has already been made in earlier paragraphs on the limitations to prevent "stepping up" the depletion or depreciation base in reorganizations where there is no substantial change in interest.

The American Mining Congress believed it desirable to have an option for depletion on a percentage of gross income (similar to that above mentioned for oil wells) extended to mines. There are various reasons for such an optional basis; aside from other considerations, it would tend to simplify the depletion question, especially for smaller taxpayers, who are not in a position to command the technical service required for a scientific valuation, the determination of discovery values and of depletion allowances. The Treasury was not prepared, however, to concur in the extension of the percentage basis of depletion to mines without further study, and the framers of the 1928 act did not therefore adopt the recommendations of the American Mining Congress on this subject. It is to be hoped that it will receive serious consideration and adoption upon any amendment of the present law.

Depletion and depreciation to life tenants—Heretofore the allowance of depletion and depreciation with respect to property the income of which went to a life tenant and the corpus of which was held in trust for a remainderman was an idle gesture. The life tenant was not allowed the deduction by reason of Section 215 (b) of the 1926 act (and similar provisions of previous acts) which

provided that "amounts paid under the laws of any state * * * as income to the holder of a life or terminable interest acquired by gift, bequest or inheritance shall not be reduced or diminished * * * by any deduction allowed by this act for the purpose of computing the income of an estate or trust but not allowed under the laws of such state * * * for the purpose of computing the income to which such holder is entitled." The underlying theory, doubtless, was that as the life tenant received the income from the property without deduction for depletion or depreciation, he should pay income tax on the full amount. On the other hand, however, the trustee of the property, who was entitled to take the deduction, because it was the corpus held for the remainderman which was depreciating or being depleted, would have no income against which to apply the deduction. Consequently, income was being taxed without any allowance for the depletion or depreciation of the property which was an inevitable incident of the production of the income.

Section 23 (k) and (l) of the 1928 act provides the practical solution that "in the case of property held by one person for life with remainder to another person, the deduction (depletion and/or depreciation) shall be computed as if the life tenant were the absolute owner of the property and shall be allowed to the life tenant." In cases where the deduction is large, this new provision will give the life tenant a valuable right and effect a material reduction in his individual income tax, even though his cash income continues unchanged and the 1928 act has made no reduction in individual rates. On the other hand, in the case of trustees for remaindermen, who had income from other property against which the depletion and/or depreciation could be applied, will experience an increase in tax to be paid.

Employes pension trust—The provision of Section 23 (q) of the 1928 act, which is new, provides for a deduction by employers for pension funds previously accumulated by the employer but now turned over to trustees for administration. This is to be additional to the contributions to the trust during the year to cover the accruing pension liability. The new provision is perhaps best explained in the language of the Senate Finance Committee report:

> A considerable number of business concerns, however, established pension plans for the benefit of their employes a good many years ago, under arrangements by which the company set aside a pension reserve fund, to which annual additions were made, the reserve fund not being turned over to a trustee. The yearly additions to such reserve funds were not deductible for income tax purposes. These employers now desire to adopt the more satisfactory plan of turning over the pension reserve funds to trustees to hold for the benefit of their employes. Under existing law, no deduction would be allowed for such a transfer representing past accumulations, though distributions from the fund are taxable to the employe as additional compensation. The committee proposes an amendment in section 23 (q) which permits such reserve funds to be turned over to a trustee and allows the amount thereof to be prorated as a deduction over a period of years equivalent to the time during which the reserve fund was accumulated. This prevents the employer from taking the entire deduction in the year of transfer and operates equitably to the employer and to the Government.

As finally enacted, the law prorates the deduction over ten years instead of over the variable period proposed by the committee.

Consolidated returns—An important change has been made by the elimination of consolidated returns in those cases in which corporations are affiliated through ownership of their stock by the same individuals. After 1928 consolidated returns will be permitted only in the case of corporations included in "one or more chains of corporations connected through stock ownership with a common parent corporation." (Section 141.) The test of "affiliation" contained in the 1924 and 1926 acts, viz, 95 percent ownership of voting stock, is continued in the 1928 act.

For 1928 consolidated returns will be permitted in both classes of affiliation recognized by the 1926 and prior acts. It behooves taxpayers of the Class B affiliation (common ownership by the same individual holders of the voting stock of two or more corporations), who may have one or more chronic losers in their group of corporations, to rearrange their corporate relationships during 1928 so as to bring them within the Class A affiliation (corporate chain) to which consolidated returns are limited for 1929 and subsequent years.

Section 45 of the 1928 act modifies materially the provisions of Section 240 (f) of the 1926 law providing for the consolidation of accounts. The earlier provision could be invoked by either commissioner or taxpayer "if necessary in order to make an accurate distribution or apportionment of gains, profits, income, deductions or capital between or among * * * related trades or businesses * * *." It has been argued, and to the writer it appears with much force, that the provision in the 1924 and 1926 acts had two purposes. The first purpose was to permit the commissioner to invoke the power of consolidating the accounts of related businesses when necessary to prevent avoidance of taxes; for instance, where foreign and domestic businesses are controlled by the same interests and the former are utilized to leave domestic businesses with a disproportionately small amount of net income subject to United States income tax. The second purpose, it is contended, was to give the taxpayer the right to consolidation of the accounts in those cases where a consolidated return might not be permissible under the technical 95 percent stock ownership requirement of the act, but where a group of businesses, nevertheless, constitute a single economic unit, and to treat them otherwise would lead to an inequitable result. As stated in Montgomery's *Income Tax Procedure* (1927 edition, Vol. I, page 108).

> "* * * it seems reasonable to construe the action of Congress as an intent to provide a means of affording relief, and resulting in substantial justice, in those cases where related businesses do not come technically within the affiliation definition, either because of stock ownership not being quite up to 95 percent or because of one or more of the related businesses being in other than corporate form. It is analogous to the framing of the excess and war profits acts in which, after laying down various formulae for computing invested capital and applying graduated rates of the tax on the basis thereof, further provisions were inserted to provide relief in those cases where inequity or hardship would result from the strict application of the technical provisions of the act."

The 1928 act materially restricts the provision, and limits the initiative in its use to the commissioner, though this need not limit his use of it "to prevent evasion of taxes"; he is still at liberty to use it in order "clearly to reflect the income of any such trades or businesses." The permission or direction of the 1926 act to "consolidate the accounts of such related trades or businesses" is now changed to read merely that "the commissioner is authorized to distribute, apportion, or allocate gross income or deductions between or among such trades or businesses, if he determines that such distribution, apportionment, or allocation is necessary * * *." The change in language may well be significant. The 1924 and 1926 acts apparently permitted the necessary adjustment to be made in appropriate cases by consolidating the income of the related trades or business in the manner long recognized in accounting and business practice and, after reaching a consolidated net result, make an allocation on an equitable basis among the related trades or businesses. Under the 1928 act, however, any distribution, apportionment or allocation would have to be made of the gross income or deductions, respectively.

It is to be noted that in the 1928 act the trades or businesses subject to the provision above mentioned need not be "related." The only requirement is that they be "owned or controlled directly or indirectly by the same interests."

ADMINISTRATIVE

Mention will be made in the following paragraphs only of those changes in administrative features of the Federal income tax which are of fairly general interest to taxpayers.

Limitation of assessment period—Congress has reduced from time to time the statutory period within which the commissioner is directed to determine finally and assess the income tax payable by taxpayers. The 1928 act (Section 275) limits the period to two years, as compared with the five years permitted for returns for the years 1917 to 1920 and lesser periods of four and three years for intervening years.

Provision is made for earlier determination and assessment in the case of income received by decedents, their estates while in administration, and of corporations about to dissolve.

Waivers—In spite of the constantly narrowing limitation on the time for assessing additional taxes, the effect thereof is more or less lost to taxpayers by the statutory provision for agreements between the commissioner and the taxpayer for extension of the assessment period. The taxpayer has in practice but little option as to whether he will or will not file a waiver requested by the Commissioner, as refusal to do so would ordinarily precipitate an arbitrary assessment.

Sections 276 and 506 of the 1928 act make it clear that after 1928 a waiver will not be valid unless given prior to the expiration of the statutory period for assessment or any extension thereof. There is more or less question concerning the validity of waivers which the commissioner secured in some cases after the expiration of the statutory period.

Expiration of limitation period—Section 1106 (a) of the 1926 law, which provided not only that the Treasury should not attempt to collect taxes for which the statutory period of collection had expired but that the liability therefor is automatically extinguished by the running of the statute, was repealed as of the date of the 1926 act. Section 607 of the 1928 act provides retroactively that if any tax, or interest or penalty thereon, is assessed or paid after the expiration of the respective statutory periods, it shall be considered an overpayment, which is to be credited or refunded, provided a timely claim was filed therefor.

An exception is made by Section 611 in the case of any tax which was assessed prior to June 2, 1924, and the collection thereof stayed by the filing of a claim in abatement. The collection of such tax, either before or within one year after the passage of the 1928 act, is not to be considered an overpayment to be refunded because either assessment or collection was made after expiration of the respective statutory periods.

As to the Treasury's rights, Section 608 provides that a refund shall be considered erroneous

(1) If made after the statutory period had expired without a claim being filed therefor;

(2) If a timely claim was rejected after passage of the 1928 act and reopened and refund made after period for institution of suit by taxpayer had expired unless

(a) a suit had been instituted within the statutory period therefor, or

(b) within such period the commissioner and taxpayer agreed in writing to suspend the running of the statutory limitation for filing suit until final decision in one or more named cases then pending before the Board of Tax Appeals or the courts.

Under Section 610 any suit by the Treasury for recovery of an erroneous refund must be brought within two years of such refund.

Section 609 contains provisions respecting credits which are similar in principle to those of Sections 607 and 608 regarding refunds. One effect of this section will be to prevent the commissioner from continuing the practice of crediting overassessments against outlawed assessments of tax and thus indirectly collecting tax after the statutory period for collection had expired.

Refunds and credits—The period within which claims must be filed for refund or credit of tax paid under the 1928 act is two years from date of payment. This reduced period corresponds with the shorter period for assessing additional taxes, which is two years from date of filing the return. There is a discrimination against taxpayers, however, in that the statutory period for assessing the tax may be extended by the commissioner through securing a waiver from the taxpayer, whereas there is no similar provision with respect to refunds or credits. Fairness to taxpayers calls for a provision in the law that the giving of a waiver for the purpose of extending the period of assessment shall likewise extend the period for filing of claims for refund or credit.

The 1928 act by Section 322 (c) gives a petition filed with the Board of Tax Appeals the effect of a claim for refund of any overpayment determined by the board to have been made within two years of the filing of a petition for any year with respect to which the commissioner had claimed a deficiency to exist.

Interest on refunds—The 1928 act makes a highly desirable change in the previous practice of paying interest only to the signing of the first overassessment schedule by the commissioner. In some cases the interval between this event and the actual payment of the refund was as much as a year. Under the new law interest is to be paid to within at least 30 days of the date of the refund check.

MINE DEPRECIATION

Should the Internal Revenue Bureau decide on uniform rates of depreciation allowances for the mining industry, the present tax law prescribing depreciation according to the peculiar conditions in each case may have to be amended by Congress. This statement was made by the Tax Division, of the American Mining Congress which recently headed a delegation of mining men in protest to officials of the bureau against the proposed change. The American Mining Congress points out that the proposal to standardize depreciation rates applies not only to mining but to all industries, and was advanced by officials of the bureau two years ago. The theory of officials of the bureau favoring the change is that depreciation rates on similar types of equipment can be standardized with certain minimum and maximum limits within which the taxpayer would not have to furnish detailed proof. Opposition was first expressed by the mining industry when the bureau in 1925 proposed to ask taxpayers for detailed depreciation schedules covering a period of 25 years, on the ground that it would have been greatly expensive to furnish this voluminous data, and it resulted in the abandonment of this statistical program by the bureau. After a lapse of two years officials of the bureau again this year advocated uniform depreciation rates. Their plan of uniform depreciation rates was recently opposed by a mining delegation before officials of the bureau and the matter of adopting the standard rate proposition or allowing the procedure which has been in effect since the internal revenue law was passed of having depreciation based in accordance with the peculiar conditions in each case to continue is before Commissioner Blair who is expected to render a decision early in the fall. In discussing the position of the mining industry in favor of the present law and against the change suggested by bureau officials, the American Mining Congress says:

"A majority of those engaged in the production of minerals are computing depreciation on plant and equipment in the unit method, which is to spread their depreciation over the units of production. There has been no complaint concerning methods of taking depreciation allowances under the present law. Taxpayers are not likely to voluntarily request the bureau to make an investigation looking to standard rates. For these reasons the uniform rate proposal appears to the mining industry to be impracticable."

CAN OIL SHALE BE MINED *by* STRIPPING METHODS?*

Fig. 2—Typical formation in Colorado shale areas near De Beque at an altitude of 7,000 feet

By F. E. CASH† *and* M. W. VON BERNEWITZ‡

Investigations Of The Bureau Have Led To The Conclusion That Only A Small Percentage Of Oil Shale Deposits Can Be Recovered Through Stripping Methods—A Review Of The Various Deposits And A Brief Description Of Possible Methods Of Mining Which May Be Utilized In Their Recovery

DURING the preparation of a Bureau of Mines bulletin on stripping and mining methods for various minerals, consideration was given the feasibility of stripping Colorado oil shale. An investigation of methods and costs led to the conclusion, already reached by many engineers who have considered the problem, that the mining of oil shale by stripping methods is feasible for only a few minor deposits. Following are abstracts from United States Bureau of Mines Bulletin 210 (1922) by M. J. Gavin, entitled "Oil Shale: an Historical, Technical, and Economic Study" (pages 21-26, 111-112), and from other sources, with photographs to illustrate the points discussed.

OCCURRENCE OF AMERICAN OIL SHALES

Oil shale deposits are found in many parts of the United States. Those to which particular attention is now being directed and which have perhaps greatest economic importance occur in Colorado, Nevada, Utah, and Wyoming. The richest are in the Rocky Mountain region and belong to the Green River formation (mostly shale) of Eocene age. The shales of Nevada possibly are slightly younger than the Green River shales, and most of those of Montana are certainly older (Upper Paleozoic). The black shales of the Eastern States—Illinois, Missouri, Indiana, New York, Kentucky, Ohio, Pennsylvania and Tennessee—occur mainly at one general horizon in the Upper Devonian, although there are extensive deposits in the Lower Devonian and Ordovician; those of California, which strictly speaking are not true oil shales, belong to the Miocene of Tertiary age, possibly with minor exceptions.

Shales of the Devonian formation, yielding notable quantities of oil, have been reported in Missouri, Kansas and Arkansas. Oil shale is known to occur in Texas also but not in this formation. In a few places oil shales of carboniferous age overlie coal beds worked by open pits, so that the removal of the overlying shale is necessary.

WESTERN STATES

The oil shales of the Green River formation are found in Garfield, Mesa, and Rio Blanco Counties of northwestern Colorado; in Uinta, Sweetwater, and Lincoln Counties of southwestern Wyoming; and in Uinta, Duchesne, Carbon, and Wasatch Counties of northeastern Utah. Of these oil-shale areas, the largest now known is in Utah. (See Figure 1.)

Colorado

In Colorado the oil shales lie nearly horizontal, except for occasional local displacements and foldings, and appear to be relatively uniform in thickness and yield. The oil-yielding shales usually outcrop high on the sides of steep-walled canyons and are darker and more resistant to weathering than the barren beds. (Figure 2.) They are 6,000 to 8,000 feet above sea level. The regions in which the shales occur are mostly arid or semiarid, sparsely populated, and in general not well supplied with transportation facilities or water.

Nevada

In Nevada the oil shales occur mostly in the eastern district near Elko and Carlin. They differ physically and chemically from the shales of the Green River formation. The shales generally lie in somewhat shallow basins of considerable extent. As a rule the beds are rather thin, dip steeply, and are extensively folded and faulted. Mining conditions are not as favorable as in most parts of the Green River formation. At the Catlin mine near Elko, according to S. K. Kirkpatrick in *Chemical and Metallurgical Engineering* for November 17, 1924, the 5-ft. bed has a dip of 22 to 25 degrees. It was opened by two incline shafts sunk to 350 ft. and 700 ft. and connected.

California

The California deposits, for the most part, are hardly true oil shales, as the greater part of the oil obtained from them occurs as such and can be extracted by suitable solvents. The most extensive deposits in that state, which are part of the Monterey formation of Tertiary age, differ very much physically and chemically from the oil shales of Scotland and from others in the United States. The mineral matter of the shale is diatomaceous, and the beds that yield oil occur in massive formation. They are much softer than the other oil shales mentioned, are not at all flexible, are brown or brownish-yellow, and when

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freshly broken smell strongly of petroleum. In many places the deposits are very thick and are accessible; therefore, notwithstanding their low yield of oil, they have economic possibilities.

Montana

The oil shales of Montana occur at two distinct geologic horizons, one in the Phosphoria formation, probably of Permian age, and the other in Tertiary beds. The shales of the former outcrop along the slopes of the chief mountain ranges, are in steeply dipping beds, and are extensively faulted. The Tertiary oil shales occur in long narrow basins and are of small extent; they are interstratified with sandstones, sandy shales, and lignite.

Eastern States

In some of the eastern states it is possible that deposits of oil shale of economic richness may be found. Private individuals have made reports on shales —especially in Kentucky, Illinois, and Missouri—that are rich enough, because of the probable cheapness and ease of mining, to make their development almost if not quite as feasible as that of the shales of Colorado, Utah, and Wyoming.

Kentucky

According to a communication from C. S. Crouse, in the University of Kentucky to M. J. Gavin, by far the greater part of the Devonian rocks, which with the Silurian form about 3 to 4 percent of the total area of the State of Kentucky, consists of Devonian black shale or oil shale. (See Figure 3.) This means that thousands of acres are amenable to power-shovel mining. Although much of the state is underlain at various depths with this material, which thus forms an immense potential source of oil, yet it is practically valueless at present because underground mining would be necessary. These shales are known in different areas as Ohio shale, New Albany shale, and Chattanooga shale.

In mining the shallower deposits gravity will be of great aid; these deposits are near railroads, and water is plentiful.

POSSIBLE MINING METHODS

Western States

Oil shale is tougher than coal; most of the deposits are horizontal or nearly so; and those in the Rocky Mountain region usually outcrop high up in the walls of canyons and lie at altitudes of 5,000 to 8,000 ft. (Figure 4.) In such cases most mining engineers believe that oil shale will be mined by methods similar to those used in coal mining and at about equal cost. The impression has been created that shale can be mined by open-cut or quarrying methods, permitting the use of power shovels. Although

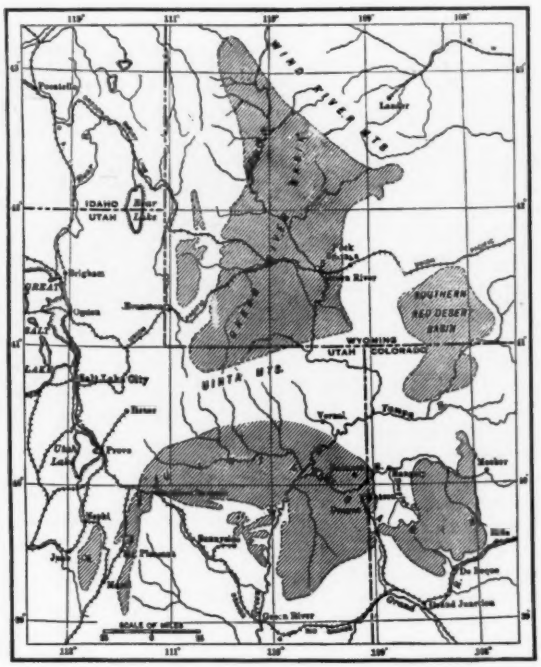


Fig. 1—Oil-shale areas of Colorado, Utah, and Wyoming, according to Winchester in Bulletin 641 (1917) of the U. S. Geological Survey

Fig. 3 — Outcrop of Devonian black shales in Indiana, Kentucky and Ohio, according to Jillson in Volume 30 (1927) of the Kentucky Geological Survey

Fig. 4—Shale formation at head of Cottonwood Creek Canyon, Colorado

Fig. 5 — Oil-shale south of Watson, Utah — a possible strip deposit

this is undoubtedly true for some shales in the eastern states, there are probably few deposits in Colorado, Utah, or Wyoming where shovel methods can be employed. In the latter region the workable beds are, as a rule, relatively thin and are usually covered by comparatively great thicknesses of overburden. Preliminary mining, in many cases, may be carried on by benching and quarrying methods, possibly followed by a period of stripping operations. After a short period of large-scale development, most of the shales will be extracted by underground methods similar to those used in mining coal, although the methods may tend to be more along the lines of certain metal-mining methods. In the Uinta basin of Utah there are areas that lend themselves to stripping, some of them with little or no overburden. (Figure 5.)

However, in many cases there are few accurate data at hand regarding the thickness and richness of the beds. Comprehensive core-drilling, or some other method of determining the thickness of the various shale seams and of obtaining accurate samples of the geologic column in the shale formations, will do much to determine the feasibility of various methods of mining. It is recommended that work of this nature be done in some manner whereby the results may be made public for the benefit of all who are interested in the development of an oil-shale industry.

Some mining authorities have considered favorably the possibility of recovering oil shale by stripping or by glory-hole methods, or by a combination of both, and so recovering and retorting great thicknesses of shale. Considerable discussion has been given to the possibility of mining several hundred feet of the Green River formation in Colorado by such methods. The feasibility of such a scheme is undoubtedly due to the fact that several hundred feet of this formation will yield oil. However, the yield of the greater part of the upper portion of this formation is so low that it is doubtful whether it would be ever economical to handle it. Gavin's experience with oil-shale retorting convinces him that it will be many years before it will be possible to retort economically a shale yielding less than 25 gallons of oil per ton. The greater portion of the Green River formation of Colorado, which it is proposed to mine by stripping or glory-hole methods, yields oil at a rate so much less than this that even when the richer part of the formation is mixed in, the resultant yield would still be too low for economical working.

Opinions of Engineers Regarding the Mining of Oil Shale

(1) There is no question at all that in a large part of the oil-shale area in Colorado, oil-yielding shale could be stripped; but so far as known there are very few places where shale of economic retorting value could be recovered by this method. In effect, the question of mining methods depends upon the richness of the shale that can be treated economically. Personally, Gavin favors the undercut-caving method, somewhat as suggested by Fred Carroll, mining engineer of Denver, in *The Mountain States Mineral Age* for May, 1926.

(2) W. R. Crane, mining engineer of the United States Bureau of Mines, who examined some of the shale deposits during 1926, expresses the opinion that if 50 ft. of the overburden can be removed economically, then the oil shale can be stripped. There are places on the mesa where the cover is thinner, but it thickens rapidly from the outcrop and he fears that it would be much too thick to remove for a low-grade product such as shale.

(3) C. Lorimer Colburn, mining engineer of Denver, formerly with the United States Bureau of Mines, who has made a study of the oil-shale fields in Colorado, Utah, and Wyoming, says in a private communication of November 26, 1927, that in the western shale field the zone of important shale lies in the middle third of the Green River formation. This formation is extensive and covers as a blanket a large area in northwestern Colorado, southwestern Wyoming, and northeastern Utah. Although it is considerably eroded, there are only a few places where the worthless top shales have been eroded so as to expose the valuable oil shales. There are only a few places, therefore, where stripping may be practiced in the western shale area. The greater part of the shale is advantageously situated for mining by the caving system.

(4) H. F. Lunt, formerly State Commissioner of Mines for Colorado, in volume 23 of the Proceedings of the American Mining Congress for 1920, states that to make profitable the operation of extracting oil from shale, at least 1,000 tons of shale a day should be mined. Although any discussion of mining shale must be based on a more or less uncertain assumption, the best information available indicates that any deposits that can be mined by steam shovels are too inaccessible to make it probable that they will be exploited in the early days of the shale industry. Consequently, it is reasonably safe to assume that in the beginning underground methods will be employed after preliminary open-cut mining.

(5) J. B. Jenson, in volume 23 of the American Mining Congress Proceedings for 1920, says:

"Our present mining will be confined practically to underground work and not by steam shovel, as is erroneously stated. My experience has been that not 10 per-

Fig. 6—Typical shale country in Kentucky

Fig. 7—An islolated shale hill in Kentucky

Fig. 8—Shale occurrence in Kentucky

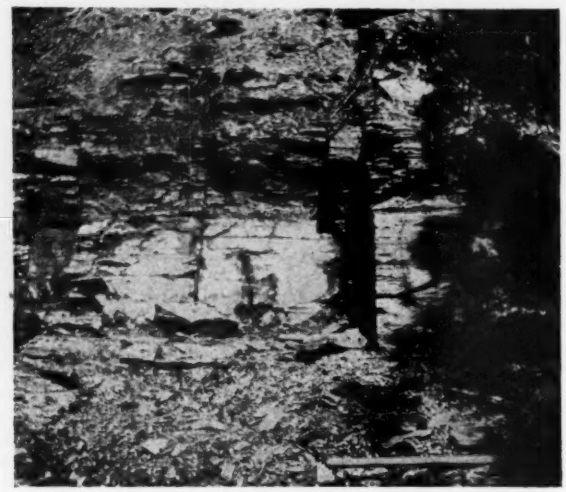


Fig. 9—Unweathered shale, blocky type, in Kentucky

cent of what is claimed to be steam-shovel deposits will be successfully worked that way for many years to come."

(6) S. D. Kirkpatrick, in *Chemical and Metallurgical Engineering* for November 3, 1924, who inspected the oil shales near De Beque, Colo., in part says:

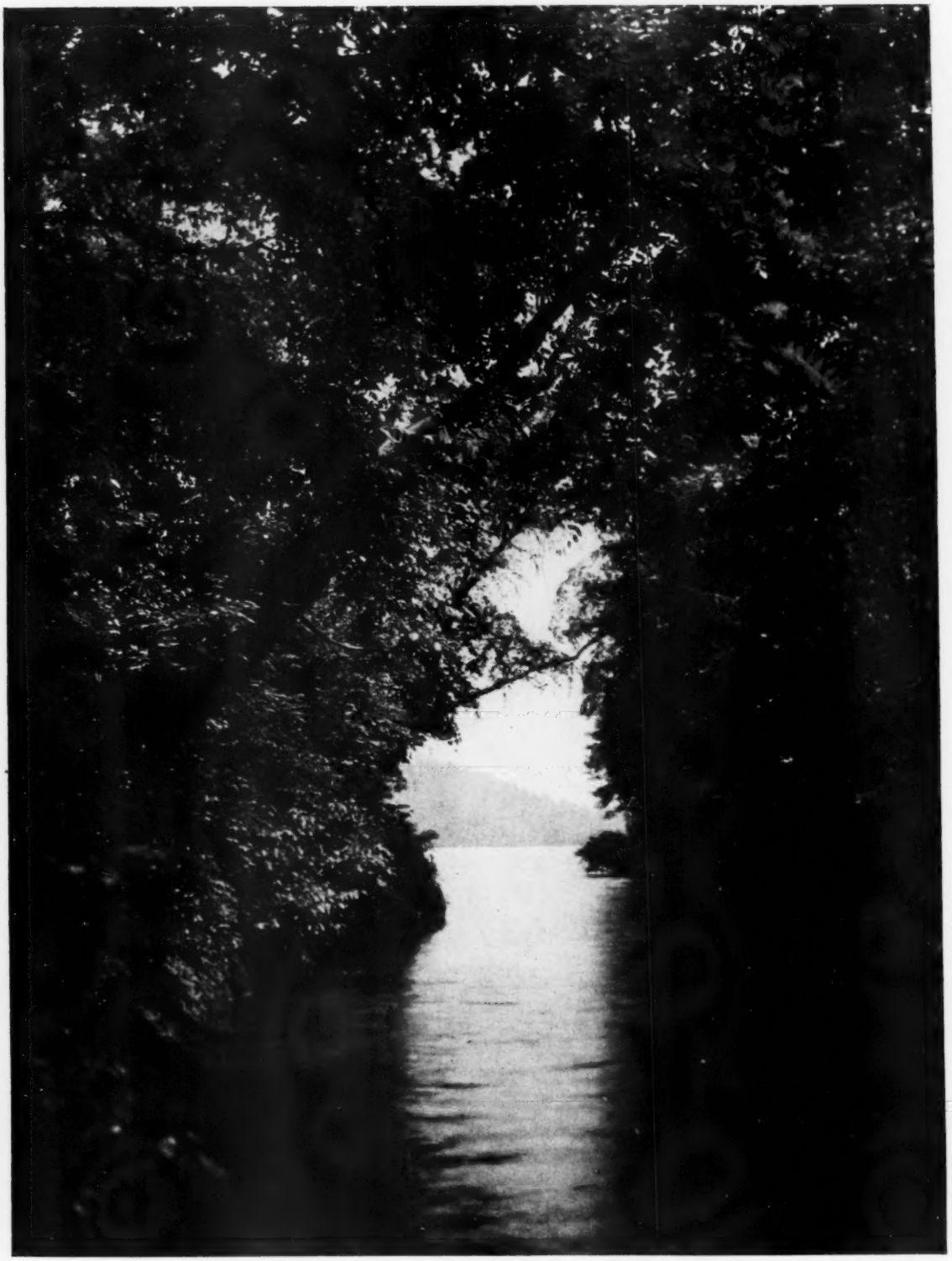
"It is an accepted prediction that most of the shales of the western deposits will be mined by underground methods. * * * In a comparatively few instances it will be possible to employ opencut or quarrying methods, at least during the earlier stages of the industry. * * * In the vicinity of De Beque, the overburden above the rich "mahogany" bed of oil shale is comparatively slight and topographic conditions would seem to favor open-cut mining. * * * Assuming 30 cents a yard as the cost of stripping off the overburden and 25 cents per ton for quarrying the shale, it was estimated by a local engineer that total mining costs for the 52-ft. bed vary from 28 cents per ton for a 25-ft. cut to 45 cents for a cut 150 ft. deep, based on the mining of 1,000 tons a day, using churn-drill blasting and electric-shovel loading."

(7) V. C. Alderson, in a 53-page review of Colorado oil shale in the *Quarterly* of the Colorado School of Mines for April, 1925, says:

"Most of the Colorado shale beds have a dip of less than 1 degree from the horizontal. For practical work, therefore, the beds are flat, and should be so regarded for mining purposes. Thus the methods of coal mining—room and pillar, or longwall—will naturally be followed. * * * In places where there is a small overburden overlying a very thick body of shale, open-cut, steam-shovel, or glory-hole methods may be economically applied. This is particularly true of the Ventura-Colorado holdings, where 320 ft. of oil shale, yielding from 15 to 68 gallons a ton are overlaid by a thin overburden. Such conditions allow mining on a large scale—5,000 to 10,000 tons a day—at a cost probably not to exceed 50 cents a ton."

(8) As what may be termed a summary of the foregoing opinions on the mining of oil shale, Report II of the Federal Oil Conservation Board, published in January, 1928, says this on page 4:

"There is wide speculation as to the method of mining that will be most practical; whether selective mining should be followed and only the richer material extracted, or whether it would be better to remove all grades of shale for a thickness of 200 to 500 ft. by steam-shovel operations or by caving methods. In many places surface mining is out of the question, due to the thickness of overburden. Estimates on the cost of mining range from as low as 40 cents a ton for steam-shovel operations to as high as $2.50 a ton for selective mining. Again, the figures on mining costs are too meager to be used for arriving at conclusions as to costs in large-scale operations." (*Continued on page* 733)



The Potomac Above Washington © *Harold Gray*

The torrent's smoothness ere it dash below

Searles "Lake," a Source of Potash

CALIFORNIA'S COMMERCIAL NON-METALLIC MINERALS

By WALTER W. BRADLEY *

THOUGH California first came into public notice and prominence as a producer of gold and still leads these United States, at present accounting for 30 percent of our domestic yield of the yellow metal, this state today has many other mineral substances under commercial exploitation and utilization. Some of these are playing even more important roles in our economic structure than our gold so famed in song and story. With increasing population on the Pacific Coast there is a gradual but sure growth in the number and character of industrial plants, established and operating, particularly in California. Quite a few nationally-known concerns have built, and others are now building, factory branches here to supply the coast markets. Such plants are also in a more favorable position to command a share of the oriental trade.

As indicated by the title, the present paper deals only with the non-metallic group of commercial minerals, those ores or materials mined for purposes other than the extraction of their metal contents. For convenience of presentation, the classification used the past 15 years by the California State Mining Bureau (now Division of Mines and Mining of the State Department of Natural Resources) in its statistical reports of mineral production will be followed, being grouped by fuels, structural materials, industrial materials, and salines.

FUELS

Though hydroelectric power is abundant and reasonable in cost in California, fuels play an important part in the industrial life of the Pacific coast alike for power as well as for other purposes. California supplies not only her own territory with fuel, lubricating oils and other derivatives of crude petroleum but large quantities of both crude and refined products are shipped to near-by and distant neighbors. The proximity of large supplies of petroleum products (likewise its attendant natural gas) at low comparative cost is an important item for consideration in the location of many industrial establishments.

Chief among California's fuels, of course, is petroleum. As this resource is so well known, and so much has been written concerning it and its derivatives, it is not our present intention to dwell at length thereon. California crude oils are all essenially of asphalt base, with a few notable exceptions.

Present Annual Value Of California Minerals Is In Excess Of Four Hundred Fifty Millions Of Dollars, Including Fuels, Metals, Structural And Industrial Materials, And Salines—A Review Of The Possibilities Of The Mineral Resources Of The State

Specific gravities in California range from 8 degrees Baumé in the Casmalia field, Santa Barbara County, to 56 degrees Baumé in Ventura County. Under present practice, oil below 18 degrees Baumé may be considered as largely refinable for fuel oil and lubricants, while the lighter oils yield varying amounts of the higher refined products with corresponding proportions of residuum and fuel oil. A decided change has taken place in the relative proportions of light and heavy crudes produced in California since 1910, taking 18 degrees Baumé as the dividing line.

A marked drop took place in the low-gravity yield from 1910 to and including 1914. From 1914 it has remained almost stationary, with a slight drop in 1921, while the high-gravity yield has increased at a rapid rate since 1915.

Natural gas is also abundant in California in those districts adjacent to the oil fields, and in addition is piped as much as 200 miles to certain industrial centers, notably the Los Angeles area. There are certain other sections, particularly Stockton and Sacramento, where natural gas is obtained and utilized not accompanied by petroleum. "Wet" natural gas in the oil fields is the source of considerable quantities of high-gravity gasoline which is recovered by compression or by absorption according to the type of plant employed. For some classes of industrial plants, natural gas is preferable for fuel to either oil or coal.

There are deposits of peat known in several localities in California, small amounts of which are used as a fertilizer and in stock-food preparations, but none has yet been recorded as utilized for fuel.

Production of coal in California was first recorded in 1861, and between 1867 and 1893 averaged in excess of 100,000 tons per year. This was principally from the Mt. Diablo district, Contra Costa County. Later, the Tesla mine, in Corral Hollow, Alameda County, and the Stone Canyon mine, Monterey County, were important shippers. There has also been some commercial production in Amador, Fresno, Orange, Riverside, and

* State Mineralogist.

Siskiyou Counties, though in lesser amounts. Considerable development work has been under way the past two years in Shasta and Mendocino Counties.

The records of the state mining bureau show that coal exists in 43 counties of California. Among these, other than those listed above, coal seams have been discovered and prospected to some extent in Butte, Del Norte, Humboldt, Placer, San Benito, San Luis Obispo, Trinity, and over 20 other counties. From their first discovery small commercial importance was attached to many of these deposits because the material is mostly of the lignite or "brown coal" variety. No bituminous or anthracite coal beds have as yet been found in California. Because of this, and of the phenomenal rise of the petroleum industry in this state, coal production, except for the years 1867-1891 and 1898-1901, has been relatively insignificant.

However, our coal resources in California are doubtless more extensive than would appear from a casual survey of the surface, and will be a potential asset for the future at such a time when petroleum may decline in quantity yield and advance in price to a point where it will be profitable to utilize our coals even though largely of inferior grades. Low-grade coals are widely distributed in other states as well as California; and experiments which give promise of success have been, and are being, made to purify lignites and low-grade coals of similar character by some process such as the Trent method.

From an industrial and metallurgical standpoint, the most serious deficiency in California's coal resources has been the lack of a local supply of suitable coking coal. Tests have shown that coke can be made from certain of our subbituminous varieties, but their practical commercial utility for metallurgical purposes has yet to be proved.

Many of these coal deposits of California will likely some day become of value as local supplies at least for domestic purposes; even though economic conditions and the quality of the product prevent a large output being placed on the general market.

Structural Materials

As the designation indicates, the mineral substances grouped under this heading are those directly employed in building and structural work. Some of these commercial minerals classed by the State Mining Bureau as "industrial" are more or less utilized in "structural" applications, but they have other uses as well. California is well supplied with structural materials. Practically any type or style of structure is possible with the wealth of local materials available. Deposits of granite, marble and other building stones in a great variety of colors and texture are widely distributed throughout the state. Although some of these deposits are as yet at considerable distances from cheap transportation facilities, yet the resource is a potential one, and will some day become economic when population and the demand calls for it.

Asphalt and Bituminous Rock

In the earlier days of the oil industry in California, considerable quantities of natural asphalt were mined from out-croppings of oil sands, the business being conducted as a separate industry from that of the production of the crude oil. For some years now, however, nearly all of the asphalt has come from oil refinery residuum, as that source yields a more uniform and better product. Such natural asphalt as is at present mined in California is in the form of bituminous "rock" or sandstone. This material is essentially an uncemented sandstone which is saturated with and held together by a natural asphaltic constituent probably the residue from the evaporation of a crude petroleum deposit. It is still being utilized to a limited extent for road surfacing in these districts adjacent to available deposits. The present operators of one of the quarries in Santa Cruz County advise that they now have on the market a product which can be laid cold, which makes it especially applicable and valuable for patching jobs.

The native bitumens or asphalts such as gilsonite, grahamite, wurtzilite, elaterite, and the mineral wax, ozocerite, are not found in California (except for certain occurrences of gilsonite and grahamite which are of mineralogic interest only, not being in commercial quantities). These minerals are especially valuable as constituents in paints, waterproofing and insulating compounds, baked enamels for auto-body finishing, and in the manufacture of rubber products including automobile tires.

Brick and Hollow Building-Blocks or Tile

Bricks of many varieties and in important quantities are annually produced in California, there being clays available and suitable for practically any type of product desired. The varieties include common, fire, pressed, glazed, enamel, fancy, vitrified, sand-lime, and others. Not only do the plants here supply practically all of our own requirements in these products, but considerable quantities are shipped to contiguous territory and certain varieties are shipped over a much wider radius. Hollow building-blocks or tile being employed in part in the same role as bricks are here included with them. Their use has been growing in popularity in recent years, not only in commercial structures, but also in dwellings.

Cement and Concrete

(Including Crushed Rock, Sand, and Gravel)

We take these, here, together because commercially they travel hand in hand. Cement, today in California, has attained to a position second only to petroleum in point of annual value of its output. It is now more than double the annual value of our gold yield. The crushed rock, sand and gravel business in this state has grown by leaps and bounds, coincident with the advance of the Portland cement industry, particularly since 1905. A study of the chart showing production curves of these two items, reveals how closely parallel their growths have been.

"Portland" cement was first commercially produced in California in 1891; though in 1860 and for several years following a natural hydraulic cement from Benicia was utilized in building operations in San Francisco. There are now twelve operating plants in nine counties, there being three in San Bernardino and one each in Calaveras, Contra Costa, Kern, Merced, Riverside, San Benito, San Mateo, Santa Cruz, and Solano. Geographically, the state is thus fairly well covered.

For crushed rock, to list the kinds and varieties utilized commercially would be to run the entire gamut of the classification scale. Much depends upon the kind available in a given district. Those which give the most satisfactory service are the basalts and other hard, dense, igneous rocks which break with sharp, clean edges. In many localities, river-wash boulders form an important source of such material. In such cases, combined washing and crushing plants obtain varying amounts of sand and gravel along with the crushed sizes.

Sand and gravel, both washed, screened, and pit-run are obtained from stream beds throughout the length and breadth of the state. Under the sand heading we also include foundry molding sands. In several localities, both north and south here, the molding sand business is becoming an important item commercially.

Today's extensive program of concrete road building, and the construction of great monolithic dams for hydroelectric and irrigation plants, to say nothing of reinforced concrete structures of all sizes and types, would be out of the question without Portland cement, which in turn requires the broken stone and sand to complete the aggregate. California is bountifully supplied with all of these constituents.

Chromite

The major consumption of chromite is for use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferrochrome for chrome-steel alloys, and of chromium chemicals.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came from California. From 1820 to 1860 the deposits in Pennsylvania and Maryland supplied the world's consumption; but following that Rhodesia and New Caledonia have been the chief producers. Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno, and Tuolumne Counties. In 1918 a total of 29 counties contributed to the state's output. Since the lapse from the high prices of the World War period, the chromite industry has languished here, because of the higher transportation costs which we must pay to put the ore into the eastern steel mills in competition with the imported foreign material. There are ample supplies in this state for such markets as may be developed locally on the Pacific coast.

Granite

For building purposes, the granites found in California, particularly the varieties from Raymon, in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at Raymond and Porterville, are unlimited. Granites of excellent quality for both building and ornamental purposes are also quarried in Riverside, San Diego, and Nevada Counties. Near Lakeside, San Diego County, there is a fine-grained "silver-gray" granite of uniform texture and color especially suited for monumental and ornamental work.

In Fresno County there is quarried a dark, hornblende diorite, called by the trade "black granite" whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly desirable for monumental and decorative purposes. Similar, but slightly lighter "black granites" are also being marketed from Tulare and San Diego Counties.

Lime

Limestone is widely distributed throughout California, and there are a number of plants which calcine the rock, producing lime which is utilized for structural purposes. The quality is excellent, and the sources economically near to the principal population centers, both north and south.

Slate Quarry Near Placerville, Calif.

Magnesite

The principal uses of magnesite (after calcination) include: refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters, other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for exterior stucoo, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. For refractory purposes the magnesite is "dead burned"; that is, practically all of the carbon dioxide gas is expelled from it. For cement purposes it is left "caustic," from 2 to 10 percent carbon dioxide being retained. When dry caustic magnesia is mixed with a solution of magnesium chloride in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours, as a tough, seamless surface.

Most of the California magnesite is comparatively pure, and is ordinarily a beautiful, white, fine-grained rock, with a conchoidal fracture resembling a break in porcelain. Because of its purity and color it is particularly suitable for plastic purposes. For refractory uses, a small percentage of iron is desirable. Some refractory megnesite has been marketed from Californian deposits.

Marble

Marble is widely distributed in California, and in a considerable range of colors and grain. There are many beautiful and serviceable varieties, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onyx marble and travertine of beautiful coloring and effects. There is also serpentine marble suitable for electrical switchboard use. Material from only a few of these deposits has been put on the market, commercially, partly because of transportation costs and partly because it is necessary to create a demand for such from architects and builders to make the opening up of a quarry an economic one.

Sandstone

An unlimited amount of high-grade sandstone, mostly in grays and buffs or yellows, is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of lighter-colored building stones and other finishes such as architectural terra-cotta, has curtailed sandstone production here during recent years almost to the vanishing point.

Slate

The color of slate is of economic importance, the common ones being gray, bluish gray, and black, though reds and various shades of green are occasionally found. The permanency of slate for roofing is well known. California has available supplies of black and gray slate that compare favorably for roofing purposes with those products found elsewhere. The principal localities are in El Dorado, Mariposa, and Calaveras Counties.

Industrial Materials

The substances segregated in the reports of the California State Mining Bureau as "industrial" numerically form quite an imposing list, although individually none of them have attained to

the magnitude in annual values shown by gold, copper, or cement for example. Many of these substances are mineral earths, or they are minerals which have specific industrial applications. Marketing becomes more of a problem when handling this type of product than with metallic ores. In some, rigid trade specifications must be adhered to as to quality and composition. So far as California is concerned, most of our "industrial" minerals have been largely dependent upon the local and Pacific coast markets, which are restricted by our limited population and fewer industrial plants than the markets for similar ores in the more populous eastern states. For this reason, development has not attained to the importance in many of these substances that it doubtless will some day or of which our resources are capable. As stated previously in connection with the structure materials, although some of these deposits are now at considerable distances from cheap transportation facilities, yet the resource is a potential one, and will some day become economic when population and the demand call for it.

Asbestos

The word "asbestos" (derived from the Greek, meaning "incombustible") as used here includes several minerals from a strictly mineralogical standpoint. There are two main divisions, however, amphibole and chrysotile. The fibrous varieties of several of the amphiboles (silicates chiefly of lime, magnesia iron), notably tremolite and actinolite, are called asbestos. Their fibres usually lie parallel to the fissures containing them. Amphibole asbestos possesses high refractory properties, but lacks strength of fibre, and is applicable principally for covering steam pipes and boilers. It is also unaffected by acids. Chrysotile, a hydrous silicate of magnesia, is a fibrous form of serpentine, and often of silky fineness. Its fibres are formed at right angles to the direction of the fissures containing them. Chrysolite fibres, though short, have considerable strength and elasticity. and may be spun into threads and woven into cloth. Chrysotile, however, is soluble in either hydrochloric (muriatic) or sulphuric acid. To bring the highest market price asbestos must needs have a combination of properties, i. e., length and fineness of fibre, tensile strength and flexibility—all combined with infusibility; and determination of the same can only be made by practical tests or in the laboratory. So far as heat resistance alone is concerned, the amphibole and chrysotile varieties are essentially equal, but the ability to be woven into cloth is the big advantage in favor of chrysotile. A large amount is used in automobile brake linings.

The poorer grades which are unsuitable for weaving are used in the manufacture of steam packing, furnace linings, asbestos brick, wall plasters, paints, tiling, asestos board, shingles, insulating material, magnesite-stucco, etc. The better grades are utilized in the manufacture of tapestries of various kinds, fireproof theater curtains, cloth, rope, etc.

A very important development of the asbestos industry is the rapidly increasing demand for the lower-grade material, on account of the numerous diversified uses to which asbestos products are being put, in almost every branch of manufacture. This fact means that many deposits of asbestos will become commercially important even though of the shortest fibre.

The future of asbestos mining in California is dependent largely upon the development of uses in quantity for the short-fibre mill grades, and for the amphibole variety. There are apparently large resources of such material that can be made available. Some spinning grade fibre has also been found in this state, notably in Nevada, Calaveras and Monterey Counties, but the commercial yield to date has been small. There are extensive serpentine areas in the Coast Ranges, in the Klamath Mountains, and in several sections of the Sierra Nevada Mountains which are within the range of possible asbestos producers, as chrysotile is a fibrous form of serpentine. These localities all yielded chromite in greater or less amounts during the World War period.

Barytes

The principal uses for barytes, after washing and grinding, are as an inert pigment and filler in paint, paper, linoleum, oilcloth and rubber manufacture, and in the preparation of lithopone and a number of chemicals.

More than half of the total tonnage of barytes utilized in the United States is taken in the manufacture of lithopone, which is a chemically-prepared, white pigment containing approximately 70 percent barium sulphate and 30 percent zinc sulphide. This is one of the principal constituents of "flat" wall paints.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta and Santa Barbara Counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

Clay

(Including also other Aluminum Silicates used in the Pottery and Porcelain Industry)

At one time or another in the history of the state, pottery clay has been quarried in 33 of its counties. In this designation "pottery clay" refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flowerpots, floor, faïence and ornamental tiling, architectural terra cotta, sewer pipe, drain and roof tile, etc. It does not include clay used in making brick and hollow building blocks.

There are many other important uses for clays besides pottery manufacture. Among these may be enumerated paper, cotton goods, and chemicals. Being neutral, clay does not have an injurious effect upon other constituents used in the manufacture of such articles. In paper making, clay is used as a filler in news and similar grades, and as a coater or glazer in the more highly-finished art papers. A large part of the china clay used in the United States is imported from England. Clays of the montmorillonite and halloysite group ("rock soap") are being utilized successfully in the manufacture of soaps.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necesasry for most clay-working plants to buy some part of their raw materials from other localities.

The State Division of Mines and Mining has recently published a report on the Clay Resources of California, which lists the various deposits, their characteristics, state of development, and products being made; also gives the results of tests made on samples from all of the important localities and many others. The ceramic industries in California are growing, and in certain branches, notably architectural terracotta, have reached a high state of perfection and commercial accomplishment.

Clays are of varying composition, the basis of which is the mineral, kaolin (hydrous aluminum silicate, when pure). There are other aluminum silicates, such as andalusite, sillimanite, cyanite, and dumortierite, which have been found to be particularly valuable in ceramic mixtures for the manufacture of high-tension-electric porcelains, such as spark plugs. Deposits of all of these have been found in California, and at present commercial shipments are being made of andalusite and cyanite.

Dolomite

Limestones are frequently more or less magnesian bearing, and a chemical

Oil Shale Distillation Plant, Casnealia, Calif.

analysis is often necessary to definitely decide as to whether they are calcite (calcium carbonate) or dolomite (calcium-magnesium-carbonate) which stands intermediate between calcite and magnesite (magnesium carbonate). Since dolomite, as such, has been found to have certain distinctive applications, we have listed it separately. An important part of the tonnage of dolomite quarried in California is utilized as a refractory lining in the bottoms of open-hearth steel furnaces, as a substitute for magnesite. Calcined dolomite has also been used by paper mills replacing an artificial mixture of calcined limestone and magnesite in the sulphite process of manufacture of paper from wood pulp. Some dolomite is used for its carbonic acid gas, and some has been burned for dolomitic lime. The principal producing districts in California thus far have been in Inyo, Monterey, San Bernardino, and Tuolumne Counties.

Feldspar

Manufacturers of pottery, chinaware, porcelain, enamel wares, also enamel brick and tile, buy most of the better grades of feldspar produced. They use it in both the body and the glaze of the various grades of ceramic products. In the body it constitutes from 10 percent to 35 percent, its value there being due to the fact that it melts during firing at a temperature below the fusing points of the other ingredients and forms a firm bond between the particles of clay and quartz. In glazes the proportion of feldspar used runs from 30 percent to 50 percent. Small quantities are used in the manufacture of opalescent glass and scouring soaps, and in emery and corundum wheels where it serves as a binder.

The most important developments quantitatively in the feldspar resources of California have thus far taken place in San Diego and Riverside Counties. Other deposits which give promise are reported from Inyo, Kern, Plumas, and San Bernardino. Some production has also come from Monterey and Tulare Counties.

Fluorspar

Fluorspar, or calcium fluoride, is one of the most important non-metallic minerals from an industrial standpoint. About 80 percent of the commercial mineral is prepared in the gravel form and utilized as a flux in the manufacture of steel for which use no substitute has yet been found. In the United States under normal business conditions, the consumption for that purpose is 125,000 to 150,000 tons annually. Fluorspar is also used in aluminum smelting, and in the manufacturing of enameled ware, glazed tile and brick, opalescent glass and certain chemicals, particularly hydrofluoric acid and its derivatives. The mineral is marketed in three forms—lump, gravel and ground.

In California deposits have been reported in Los Angeles, Mono, Riverside and San Bernardino Counties, but no commercial production has resulted except in 1917-1918, when a small tonnage was shipped from Riverside County. The San Bernardino deposits particularly seem to offer possibilities for commercial tonnages.

Fuller's Earth

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color, and some varieties disintegrate in water. In California, fuller's earth has been used in clarifying both refined mineral and vegetable oils, and for special chemical purposes; although its original use was in fulling wool, as the name indicates. Production has come mainly from Calaveras and Solano Counties, with other deposits noted also in Riverside, Fresno, Inyo and Kern Counties.

Clays of the montmorillonite and halloysite group ("rock soap") are being utilized by some of the oil refineries in lieu of true fuller's earth in the refining of petroleum products. Such production has come from Inyo, Kern, San Bernardino, and San Diego Counties.

After all, the practical test of a fuller's earth is not so much chemical as a physical one; that is, its physical capacity to absorb basic colors and to remove these colors from solution in animal, vegetable, or mineral oils, also from water.

Gems and Jewelers' Material

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to the widely scattered places at which stones are gathered and marketed for the most part in a small way.

Varieties of California's Gem Stones

Diamonds have been found in a number of localities in California; but in every case they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano, in Amador County; Placerville, Smith's Flat and others in El Dorado County; French Corral, Nevada County; Cherokee Flat, Morris Ravine, and Yankee Hill, Butte County; Gopher Hill and Upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee, in Butte County.

California *tourmalines* are decidedly distinctive in coloring and "fire" as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green, also blue.

One of our California gem stones,

benitoïte, has not been found elsewhere, and in but a single locality here, the Dallas mine in San Benito County.

Kunzite, a gem variety of spodumene, was first found in the Pala district in San Diego County. It has thus far been found in only one locality (Madagascar) outside of California. It is of a lilac color.

Beryls of excellent fire and delicate colors are also obtained in the Pala district, of which the *aquamarine* (blue) and *morganite* (pink) varieties deserve special mention. Morganite like kunzite, has thus far been found elsewhere only in Madagascar.

Californite or "California jade," is a gem variety of *vesuvianite*, and is green or white in color. It is found in Butte, Fresno, and Siskiyou Counties.

Stones of precious blue *topaz* of fine quality are being cut from crystals mined in northern San Diego County. They are associated with beryl and blue tourmaline.

Some *rhodonite* has been mined in Siskiyou County, and used for decorative purposes.

Garnets are found in a number of localities in California, the important yield of gems being *hyacinth* and *spessarite* varieties from San Diego County.

Chrysoprase has been produced in Tulare County.

Turquoise has been found in the desert section of San Bernardino County, but not produced commercially in recent years.

Sapphires have been reported found in San Bernardino and Riverside Counties, but not as yet confirmed. A few have been found in stream gravels with diamonds in Butte County.

Rubies have been identified by the laboratory of the state mining bureau, occurring in limestone from the Baldy Mountains, San Bernardino County. Thus far no stones of commercial size have been taken out.

Graphite

Graphite has been produced from time to time in the state, coming principally from Sonoma and Los Angeles counties. It is difficult for these deposits, which must be concentrated, to compete with foreign supplies, which go on the market almost directly as they come from the deposit. Graphite ores are concentrated with considerable difficulty, and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

The principal value of graphite is on account of its infusibility and resistance to the action of molten metals. It is also largely used in the manufacture of electrical appliances, of "lead" pencils, as a lubricant, as stove polish, paints and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory.

Occurrence of graphite in California has been reported at various times from Calaveras, Fresno, Imperial, Inyo, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne Counties.

Gypsum

The most important use of gypsum from the quantity standpoint is in the calcined form where it is utilized in the manufacture of various hard-wall plasters and plaster board. As plaster of paris, it plays a very important part in surgical work. Approximately 2 percent, by weight, raw gypsum is added in the manufacture of Portland cement just before the final grinding. In this application the gypsum acts as a retarder to the set of the cement. The use of gypsum tile for non-bearing fireproof partitions, stairway and elevator enclosures, and the protection of steel columns, girders and beams, has increased greatly.

Mount Shasta

Keene's cement is a gypsum product, calcined to complete dehydration, and an accelerator, added such as alum, postassium sulphate, borax, aluminum sulphate.

Land plaster may be applied to the soil by drilling, or scattered in the hill, or it may be sowed broadcast in quantities ranging from 200 to 500 pounds to the acre.

The important commercial production of gypsum in California at the present time is from Imperial, Riverside, and Kern Counties. In the past shipments have also been made from San Benito, San Bernardino and Fresno Counties.

Infusorial and Diatomaceous Earths

Infusorial and diatomaceous earths—sometimes called tripolite—are very light and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which have been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. The principal commercial use of this material is as an absorbent. It is also employed in the manufacture of scouring and polishing powders; for filtration purposes; in making some classes of refractory brick; and as an insulating medium both in heating and refrigeration. It is a first-class nonconductor of heat, where high temperatures are employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name "kieselguhr," it was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

As a non-conductor of heat it has been used alone or with other materials as a covering for boilers, steam pipes and safes, and in fireproof cements. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. It has been used for absorbing liquid manures so that they could be utilized as fertilizers, and as a source of silica in making water-glass as well as in the manufacture of cement, tile glazing, artificial stone, ultramarine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard-rubber objects, matches, and papier-mâché, and for solidifying bromide. For making insulating brick the material is sawed into blocks, and for all other purposes it is ground and screened.

The most important deposits in California thus far known are located in Monterey, Orange, San Louis Obispo, and Santa Barbara Counties. The Santa Barbara material is diatomaceous and is of a superior quality, particularly for filtration uses which bring the higher prices. Infusorial or diatomaceous earths are also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma and Tehama Counties.

The material at present being shipped is utilized for insulation, filtration, paint pigment, for clarification of gasoline and kerosene; and for water-proofing cement.

Limestone

Under this heading are included the stone utilized as a smelter and foundry flux, for glass and sugar making and other special chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural "lime"), "roofing gravel," paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken grit, carbon dioxide gas, "paving compound," facing dust for concrete pipe, also for rubber and magnesite mix. Calcareous marl sold for agricultural purposes is likewise classified under this designation. Limestone used in the manufacture of cement is not here included, nor that for macadam and concrete, nor of lime for building purposes.

It will thus be seen that limestone has many industrial applications. The quality of the material quarried varies widely with the analysis demanded by the requirements of the specific use for which it is intended. With some, color also is important. For example, that for paint and kalsomine must be white. In other cases the structure (that is, the character of the grain or crystallization) is essential. Lime rock burned in vertical, stack kilns for certain purposts must not be coarsely crystalline, as it will spall or split-up in the furnace and be irregularly and incompletely calcined.

Limestone is of widespread occurrence in California, but commercial development is dependent principally upon the economic factor of conveniences to cheap transportation, as well as upon chemical analysis and size of deposit. The principal production in recent years has come from El Dorado, Kern, San Bernardino, Santa Cruz, Shasta, Tulare, and Tuolumne Counties.

Lithia

The lithium mica, lepidolite, utilized in the manufacture of artificial mineral water, fireworks, glass, et al., has been mined from time to time in this state since 1899, principally in San Diego County. Small amounts of amblygonite, a lithium phosphate, has occasionally also been obtained from pockets associated with the gem tourmalines.

Mica

Practically all marketable mica is of the muscovite or phlogopite varieties. There are three main commercial classes; sheet mica, including punch; splittings, and scrap. Prices vary accordingly. Sheet mica is used chiefly for electrical purposes and for glazing; splittings are made into built-up mica; scrap is ground to a powder. Mica to be classified as sheet must yield a rectangle of at least 1½ by 2 in., must split evenly and freely, be free from cracks, rulings, or plications, and reasonably free from inclusions or foreign matter, though stains of a non-conducting character are permissable for some uses. Ability to withstand heat and high electrical resistance have led to a wide application of sheet mica in the electrical industries. The electrical uses of sheet mica greatly exceed all others in quantity and value of the material used.

Its ability to withstand shocks and strains, combined with its transparency, has led to wide use in motor goggles, spectacles, diver's helmets, smoke helmets, compass cards, gage fronts, and in windows subject to shock, as in the conning towers of warships. On account of its heat-resisting qualities, ground mica is used in railroad car axle packings, in pipe and boiler coverings, in fireproof paints, and in rubber tires. Ground mica is used as a component in roofing; as a filler in rubber and other products, in calico printing, and as a tire powder. It is used also in tinsel decorations, and as "Santa Claus snow" for Christmas tree and window decorations. It is used as a lubricant for wooden bearings, and mixed with oil for metal bearings.

Except for a small tonnage shipped in the years 1902-1904 inclusive, there has been no commercial yield of mica reported in California, mainly due to lack of the development of suitably-sized material for electrical appliances. Samples recently received stated to have come from Plumas County look promising.

Mineral Paint

Mineral paint pigments produced in California have included hematite, red ochre, and yellow ochre. In former years considerable red ochre of fine quality was shipped from Sonoma County, and hematite from Placer County. Yellow ochre has come from Calaveras and Stanislaus Counties, the latter still shipping moderate tonnage annually. A number of other counties have also from time to time contributed natural paint pigments, but Stanislaus is the only one at present active. There are, however, latent possibilities, not yet utilized.

Mineral Water

From a therapeutic standpoint, California is particularly rich in mineral springs. The counterparts of many of the world-famed spas of Europe and the eastern United States can be found here. Radioactivity has been noted in at least three localities in California: At The Geysers in Sonoma County, Arrowhead Hot Springs in San Bernardino County and Pariso Hot Springs, Monterey County. It doubtless exists at others but the State Division of Mines and Mining has not as yet had funds available to conduct the necessary tests and field observations to determine the data required.

A widespread commercial production of mineral water is shown annually in California. The figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having a special medicinal value brings a price many times higher than the average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing.

So far as the efficacy of radioactivity in mineral water is concerned, it has been found by investigations of the United States Geological Survey and the United States Department of Agriculture that it is not retained and transported in bottled water. Radioactivity in water is only temporary, and dissipates. To obtain whatever therapeutic elect it may possess, radioactive water should be utilized directly at the spring.

The value of mineral water production in California at the present time exceeds $1,000,000 annually, and has been increasing steadily for several years. In 1927, 19 counties contributed to the total, the more important ones being Lake, Los Angeles, Napa, San Bernardino, Santa Barbara, Siskiyou, Sonoma.

Phosphates

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithium phosphate, amblygonite, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia. There have been some occurrences of phosphates noted here, but no economic development has as yet resulted.

Pumice and Volcanic Ash

Both the block and ash varieties of pumice are found, and produced commercially in California, principally in Imperial, Inyo, Kern and Mono Counties. There have also been shipments in the past from Fresno, Humboldt, San Francisco and Shasta Counties.

The material from Imperial County and part of that from Mono is of the vesicular, block variety and is sold for abrasive purposes; the balance of the Mono material and that from Inyo and Kern is the volcanic ash, or tuff variety and is employed in making soap and cleanser compounds. The Kern County

ash is going into the preparation of one of the popular and nationally advertised brands of cleanser compounds.

Pyrites

There are two sulphides of iron which can be, and are, used for the production of sulphuric acid, namely, pyrite and marcasite. The former is the more important, commercially. Pyrite is the commonest of all the sulphide minerals, and occurs widely distributed, in a great variety of ways, and often in large quantities. Though it occurs abundantly in veins and as disseminated crystals and nodules the deposits of chief economic importance are found usually as lenticular masses of great size in both crystalline and sedimentary rocks of all ages. The most important world sources are Spain and Portugal.

In California, the principal locality is Shasta County, followed by Alameda and Mariposa. In the past, there has also been production from Calaveras and Placer Counties. Some sulphuric acid is also obtained as a by-product in the smelting of gold and silver bearing concentrates, particularly from the Mother Lode gold-belt. Material from Mariposa County is being marketed, raw-ground, as a fertilizer and insecticide. The sulphur content of the Californian pyrites marketed ranges up to 46.5 percent S.

In the United States, more especially in the eastern part, the production of pyrite has been influenced in the past by the lower price of the imported mineral (mainly from Spain); but at present, the price of domestic native sulphur from Texas and Louisiana controls the situation. Considerable quantities of sulphuric acid are also now made from waste gases at copper and zinc smelters, which have further reduced the consumption of pyrite.

Shale Oil

Oil shale is defined as a compact, laminated rock of sedimentary origin, yielding over 33 percent of ash and containing organic matter that yields oil when distilled, but not appreciably when extracted with the ordinary solvents for petroleum. Oil shales contain a substance, or substances, usually classed as a pyro-bitumen, that by destructive distillation yields oils somewhat similar to petroleum. The so-called "oil shales" of California do not for the most part conform to the above definition, as the greater part of the oil obtained from them occurs as such and can be extracted by suitable solvents.

Although the extraction of shale oil has been a matter of commercial practice on a considerable scale for many years in Scotland, France and Australia, it has not attained commercial importance as yet in the United States. Technical knowledge of the subject, however, is increasing. With the gradual depletion of the underground reserves of liquid oil, it is merely a matter of time until the development of the oil shales of the United States will be an economic necessity. The selling price of petroleum will be the determining factor. The recovery of by-product ammonium sulphate is an important feature of the process.

Two plants on a more or less experimental scale have been in operation in California for several years past, with commercial production beginning in a small way in 1922. The product, in part, has been sold for utilization as a flotation oil in metallurgical work, and part has been consumed as fuel at the plants.

Silica

(Sand and Quartz)

We combine these materials because of the overlapping roles of vein quartz which is mined for use in glassmaking and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

A portion of the tonnage of vein quartz in California in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. At present, some is utilized as a foundry flux and for steel-casting molds. A portion of the silica sold (both sand and quartz) is also used in glazes for porcelain, pottery and tile, and in the body of the ware to diminish shrinkage, and some of the sand for the preparation of sodium silicate ("water glass"). Manufacturers of paint use finely-ground silica, which forms as much as one-third of the total pigment in some paints. Part of the recent output in California was used for roofing and stucco-dash granules.

We do not include under this heading such forms of silica as quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of "rock crystal," amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations. For making the higher grades of glass most of the sand used locally is imported from Belgium. There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used as yet, owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, El Dorado, Los Angeles, Mono, Monterey, and Los Angeles Counties. The industry is of limited importance so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such it must be essentially iron free. Even a fractional percent of iron imparts a green color to the glass. Belgium sand has also displaced local material in the manufacture of sodium silicate ("water glass").

Sillimanite-Andalusite-Cyanite Group

Sillimanite and andalusite are both aluminum silicates (Al_2SiO_5), having the same composition and formula, but with slightly different physical characteistics. Colors are similar. Andalusite is lighter in specific gravity.

A massive deposit of andalusite, found in Dry Creek Canyon in the White Mountains of the Inyo Range, in Mono County, is being mined by the Champion Poreclain Company, of Detroit, Mich. The material is shipped East and utilized in the manufacture of porcelain for automobile spark plugs and for other high-tension electric insulators, also for special chemical porcelain ware.

Cyanite is also an aluminum silicate (Al_2SiO_5) of the same chemical composition as andalusite and sillimanite, but crystallizing in another system; specific gravity heavier than the other two; color, blue. A deposit of cyanite (apparently in quantity) is being developed in Imperial County, near Ogilby, and shipments made to Los Angeles.

Dumortierite, though differing somewhat in composition from the above, being a basic aluminum silicate, has proved similiar in behavior in ceramic work, so that it is now being mixed with andalusite for electrical procelains. Occurrences of massive dumortierite are known in Imperial County in this state, and there may yet be commercial possibilities for them.

Soapstone and Talc

Talc is hydrous magnesium silicate. It is also called soapstone and steatite. The term "talc" properly includes all forms of the pure mineral, whereas "steatite" denotes particularly the massive, compact variety, and "soapstone" the impure, massive forms containing as low as 50 percent of talc. When pure, talc is soft; but impurities increase the hardness. The color varies from pure white and silvery white through gray, green, apple green, to dark green, also yellow, brown, and reddish when impure. It is commonly compact or massive, or in fine granular aggregates, and often in foliated plates or in fibrous aggregates.

Although the uses of talc and soapstone are many and varied, some of them are not in general well known nor fully developed; and although few of their uses can justly be considered essential in the sense that no substitutes can be used, there are several which are of great im-

portance. The widest use of talc is in the powdered form, and the value depends upon color (whiteness), uniformity, fineness of grain, freedom from grit, "slip," and sometimes freedom from lime.

The white varieties, free from grit and iron, low in lime, ground to 200-mesh and finer, are largely used as a filler for paper, rubber and paint, and the very highest grade as toilet powder. Ground talc is also used in dressing and coating cloth in making soap, rope, twine, pipe covering compounds, heavy lubricants, and polishes. Ground talc and soapstone are used for foundry facings, either alone or mixed with graphite, and a coarser grade is used in the manufacture of asphalt-coated roofing felts and papers, both as a filler and as a surfacing. Massive close-grained talc, free from iron and grit, is cut into blanks and baked, forming the material used for gas tips and electrical insulation, commonly known as "lava." Its hardness, its resistance to heat, acids and alkalies, and its great dielectric strength make it very useful for electric insulation, and no satisfactory substitute for it has been found.

Massive varieties of talc, pyrophyllite, and high grades of soapstone are cut into slate pencils and steel-workers' crayons. "French chalk," or "tailor's chalk," is a soft, massive talc. In China, Japan and India massive talc (steatite) is carved into grotesque images and other forms, and is often sold as imitation jade. Soapstone is cut into slabs of 1 to 2 in. in thickness and sold as griddles, foot-warmers, and laboratory-table tops, hoods, tanks and sinks, electric switchboards, and for other uses in which the properties of resistance to heat, acids, and alkalies, and electricity are essential.

Foreign importations of high-grade white talc suitable for the manufacturers of toilet powder have come mainly from Canada, Italy and France. Foreign producers have the benefit of cheap labor and a low tariff import duty. In addition to these disadvantages, California operators have to contend with transcontinental freight rates to the eastern manufacturing centers. It is reported that California talc is steadily replacing imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of massive soapstone from Virginia.

Nearly 80 percent of the product in California at present is high-grade talc, mainly from Inyo and San Bernardino Counties, some also from Shasta, and is utilized mostly in toilet powders, paints, paper, and rubber manufacture, some also in ceramics and for polishing rice. The "soapstone" grades are being used mainly for roofing granuels and as a filler in roofing paper, and part also in magnesite cement mixtures.

CONTRASTING CALIFORNIA GOLD MINING METHODS

In the Old North Bloomfield Hydraulic Mine, Nevada County, Calif.

Kennedy Mine, Jackson, Calif.

STRONTIUM

The principal use for strontium in the United States is in the form of the nitrate in the manufacture of red flares, or Costen and Bengal lights and fireworks. (Previous to 1914 the nitrate was imported from Germany, England and Sicily.) In Germany and Russia strontium in the form of the hydroxide is used in the manufacture of beet sugar.

Of the two principal strontium minerals, strontianite (carbonate) and celestite (sulphate), the carbonate is the more desirable as it is easier to convert to other salts; but it is scarcer. (Celestite is found with limestone and sandstone and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.) There has been no production of strontium minerals in California since 1918, though in that year both celestite and strontianite were shipped. The occurrence of the carbonate is particularly interesting and valuable, as it appears to be the only considerable deposit of commercial importance so far opened up in the United States. Shipments reported as averaging 80 percent $SrCO_3$ have been made. The deposit is associated with deposits of barite, near Barstow, San Bernardino County. The carbonate has also been found in massive form near Shoshone, Inyo County. In addition to Imperial County, celestite is found near Calico and Ludlow, and in the Avawatz Mountains in San Bernardino County, but as yet undeveloped.

SULPHUR

At present by far the largest use of sulphur is in the manufacture of sul-

phuric acid. Up to the year 1895 over 75 percent of the acid produced in the United States was made from sulphur, following which it was gradually replaced by pyrite until in 1900, but little sulphur was so used. From 1914 the pendulum has swung back until now sulphur is again in the lead. Texas and Louisiana are the principal sources. Formerly considerable sulphur was imported from Italy and Japan; but the situation is now reversed, and we export large tonnages to Europe and to Canada.

In California sulphur was produced at the famous Sulphur Bank mine in Lake County, during the years 1865-1868, inclusive, following which the property became more valuable for its quicksilver. The Elgin quicksilver mine near Wilbur Springs, Colusa County, also has a considerable body of native sulphur available. In 1923-1924 there was a small production from a deposit in Kern County, the material being ground and utilized as a fertilizer and in dusting for mildew. In addition to these, occurrences of sulphur have been noted in Imperial, Inyo, Sonoma, Tehama, and Ventura Counties.

Salines

This group includes the borates, common salt, soda, potash, magnesium chloride and sulphate, calcium chloride, and bromine. These has been as yet no commercial production of the nitrates in California. Borax and common salt have been produced in a number of localities here more or less regularly since the early sixties; either soda ash or salt cake since 1894, and the others noted in more recent years. Bromine recovery began in 1926.

Borates

Borax was first discovered in California in the waters of Tuscan Springs, in Tehama County, January 8, 1856. Borax Lake, in Lake County, was discovered in September of the same year by Dr. John A. Veatch. This deposit was worked in 1864-1868, inclusive, and during that time produced 1,181,365 pounds of refined borax, the bulk of which was exported by sea to New York. This was the first commercial output of this salt in the United States, and California is still today the leading American producer of borax, having been for many years the sole producer.

Production from the dry lake "playa" deposits of Inyo and San Bernardino Counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico, in San Bernardino County. These have since been largely worked out, and the output for a number of years came from similar beds in Inyo and Los Angeles Counties. The colemanite deposits of Ventura County are as yet unworked, owing to lack of transportation facilities.

Colemanite is a calcium borate, and the material mined was shipped to seaboard chemical plants for refining. The latest development in the borax industry is the finding in quantity and opening up of a new borate mineral which bids fair to supplant colemanite in much the same way that the colemanite deposits displaced the borax industry in the desert playas or dry lakes, some 40 years ago. This new mineral is "kernite" (or "rasorite") a sodium borate with a smaller water-of-crystallization content than the "borax" of commerce, so that when recrystallized to borax, the resulting product has an increased weight over the original material. These deposits are being opened up by the Pacific Coast Borax Company in southeastern Kern County. An important tonnage of refined borax is now recovered, also, from the brines of Searles Lake, San Bernardino County, by the American Potash and Chemical Corporation as a by-product in the crystallization of potash salts.

Bromine

During 1926 commercial production of bromine and bromine compounds was begun by the California Chemical Corporation at Chula Vista, San Diego County, and by the Industrial Chemical Company at Newark, Alameda County, both from salt-works bittern waters. Both these plants, for some years past have been recovering magnesium chloride from their bitterns.

Calcium Chloride

Calcium chloride is hygroscopic; that is, it has an affinity for water. This property is taken advantage of by utilizing this salt as a drying agent. It is also sprinkled on dirt roads and playgrounds to keep down dust by absorbing moisture. In refrigerating machinery for ice factories, meat-packing house and cold-storage warehouses, a calcium-chloride solution is stated to have some advantages over salt brine.

Commercial production of calcium chloride in California was first reported to the state mining bureau in 1921, from two plants in San Bernardino County, being obtained as a by-product in the refining of salt from deposits in certain of the desert dry lakes.

Magnesium Salts

With the use of magnesite cement and stucco coming more into prominence in building construction on the Pacific coast, the demand for magnesium chloride is increasing here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

Commercial production of magnesium chloride in California was begun in 1916 by some of the salt companies, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride. In addition, some magnesium sulphate, or "Epsom salts," is also made annually, but in smaller amounts. The chloride is sold principally for use in magnesite stucco and cement mixtures (Soreal cement), also some for "road liquor." It is in part marketed in the liquid form testing 34-36 degrees Baumé, and in part as dry crystals, and is prepared from residual bitterns at salt plants in Alameda, Los Angeles, San Diego, and San Mateo Counties. The sulphate marketed is utilized for medicinal and bath purposes.

Nitrates

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. It is hoped that a closer search may some day be rewarded by workable discoveries. At present the principal world source of nitrates is the Chilean saltpeter (sodium nitrate) deposits in South America.

The fixation of atmospheric nitrogen electrically has been accomplished successfully in Germany and Scandinavia. The possibilities of cheap hydro-electric power in California make the subject one of interest to us, as we have also the natural raw material and

(*Continued on page* 718)

The AMERICAN PETROLEUM INSTITUTE

W. R. Boyd, Jr., Asst. Gen'l Secretary and Counsel

E. W. Clark President

R. L. Welch, Gen'l Secretary and Counsel

M. W. Mattison, Director, Div. of Taxation and Accounting

Dr. R. P. Anderson, Technologist

Underwood & Underwood

The Petroleum Institute Was Organized As A Means Of Cooperation Between Government And Industry; To Foster Foreign And Domestic Trade And To Promote In General The Interests Of The Petroleum Industry—This Brief Outline Of Its Activities Indicates The Success It Has Achieved

By L. M. FANNING*

THE American Petroleum Institute was formed in 1919, an outgrowth of the activities of the National Petroleum War Service Committee, which service revealed the advisability and necessity of a permanent organization of such character. The Institute is an association of more than 4,000 persons engaged in the oil and allied industries. Membership is individual and companies as such are not members.

The objects of the Institute as expressed in its charter are as follows:

(a) To afford a means of cooperation with the Government in all matters of national concern; and

(b) To foster foreign and domestic trade in American petroleum; and

(c) To promote in general the interests of the petroleum industry in all its branches; and

(d) To promote the mutual improvement of its members and the study of the arts and sciences connected with the petroleum industry.

The principal divisions of the Institute are: Accounting and taxation, standardization, development and production engineering, technology, statistics, and public relations.

*American Petroleum Institute.

Speaking of the objects of the American Petroleum Institute at one of the annual meetings of the association, J. Edgar Pew, at that time president, said: "The word 'Institute' suggests an organization for the advancement of educational, scientific, or social affairs. The American Petroleum Institute is a national organization, especially adapted for handling the problems of a general character affecting all branches of the oil industry and for bringing together in a closer fellowship all of those engaged in this great industry. It should, in fact as in name, represent the ideals of the industry, and should stand for integrity and service. It should elevate the industry before the public and before the Government, so as to inspire their confidence in its purpose to serve the public wisely, efficiently, and honestly."

CONSERVATION AND COOPERATION

One of the most important matters which has held the attention of the Institute is that of conservation. In December, 1924, President Coolidge appointed the Federal Oil Conservation Board, comprised of the Secretaries of War, Navy, Interior, and Commerce. Dr. Hubert Work, Secretary of the Interior, is chairman of the board. The intensive studies of the problem conducted by the Federal Oil Conservation Board were participated in by oil executives, scientists, and by the Institute, which also has conducted, and is conducting, independent investigations designed to cooperate with the Federal board.

In consequence of the creation of this board, appointed for the purpose of making a study of the Nation's future supply of petroleum, a "committee of eleven" was named from the membership of the American Petroleum Institute, who in March, 1925, formulated a report which was published in August of that year, entitled "American Petroleum — Supply and Demand."

After a period of investigation of the facts, the Federal Oil Conservation Board, in its preliminary report of September, 1926, invited the industry to concentrate its thought and attention upon two great general principles—one in respect to the development of coopera-

tion, and the other in respect to the use of gas, or energy as it is sometimes put, in producing oil.

At the annual meeting of the American Petroleum Institute at Tulsa in 1926 resolutions covering the use of gas in oil production and the development of cooperation were adopted by the board of directors.

After a year of intensive study the two committees thus organized reported substantially as follows: *First*, that the oil-producing states should pass a simple enactment making it lawful for operators and others at interest to make agreements whereby the production of crude petroleum can be diminished or postponed during periods of overproduction; and, *second*, that the Institute should favor the enactment of laws to prevent the waste of natural gas "by the various oil-producing states in which natural gas is being unnecessarily wasted."

A great amount of technical work has been done on determining the function of natural gas in oil production through a subcommittee of one of the reporting committees.

The American Petroleum Institute has three representatives of the nine members of the committee appointed by Chairman Work, of the Federal Oil Conservation Board, to study possible legislative steps designed to effect greater conservation of the country's natural petroleum resources. This committee recently made an exhaustive report. It is comprised of three representatives of the Government, three of the oil industry, and three of the American Bar Association.

The American oil industry is now engaged in a cooperative effort to solve its own problems and to further improve all methods of operation, according to E. W. Clark, president of the Institute.

The American Petroleum Institute affords a medium for free exchange of ideas and information between executives and departments of all oil companies.

Technical research problems are being studied under careful guidance and control.

Committees are at active work in an effort to find means for more intelligent and economical development of oil lands and in a study of possible legislation which would afford greater freedom in cooperative control of production and distribution.

The membership of the American Petroleum Institute and the body of the entire industry stand pledged to cooperation with the Federal Oil Conservation Board in furtherance of President Coolidge's policy.

Accounting and Taxation Activities

Work on uniform accounting for the adoption of oil companies began under the auspices of the American Petroleum Institute four years ago. As a result of intensive cooperative work devising forms and methods, a great many oil companies have now adopted the American Petroleum Institute uniform balance sheet and are adopting the uniform income account. This action by the oil companies is the first instance of a nation-reaching business divided into many highly competitive units voluntarily attempting to devise and impose upon itself such a system.

A form of balance sheet and method of accounting, including all of the industry's varied operations, was devised in such detail as to give a model system for each particular department or division. This made it possible for a company with limited operations to adopt from it a complete manual for its own branch of the industry. The form of uniform balance sheet was provided by the directors of the American Petroleum Institute in December, 1926, and last year was rapidly adopted. In December, 1927, the directors approved all the detail of revenue and expense accounts and ratified the published income statement. A complete classification of all material used showing what classes go to ordinary replacement, what are to be charged to current expense, and what are to be treated as additions to capital is now being devised. The accountant will thus know how to distribute charges as between capital and current operating expenses.

The purpose of this work throughout has been to determine accurately the items of invested capital and earnings, to provide absolute uniformity of method in fixing these factors, and to make it possible for the investor and the public to know the results of operations of the individual company, and accurately to compare the results for different companies, as shown by their balance sheets and statements.

Marketing

Under the auspices of the American Petroleum Institute country-wide committees have been organized to formulate a national "Petroleum Industry Code of Ethics" to apply to the marketing of petroleum products. These committees have just recently been appointed under a resolution adopted by the executive committee, which follows in part:

"It is the judgment of the executive committee of the American Petroleum Institute that, in the interest of the petroleum industry and the public, the Institute should formulate, and its board of directors adopt, a code of ethics which the Institute can recommend, subject to the approval of the Federal Trade Commission and the Department of Justice, to the petroleum industry and the respective units thereof and men engaged therein as recognized good, ethical, and lawful practice for competitors to pursue."

Standardization

Great progress has been made in standardizing oil field equipment and methods through the Standardization Division of the American Petroleum Institute.

Specifications have been completed on 90 percent of the equipment used in the drilling and producing of oil. The savings accruing from the use of proper standards can only be measured in millions. This opportunity for saving is not so much direct economies that will obtain in reduced warehouse stocks and increased flexibility in the handling of materials, but also the elimination of losses caused by fishing jobs due to improper threads, inability to secure proper mating parts in emergencies, etc. Standardization enables the buyer and seller to speak the same language. It speeds up the entire drilling and producing program at less cost.

Some concrete illustrations of this economy, resulting from simplification and standardization, may suffice:

Three hundred and six different sizes of cable drilling tool joints reduced to 11.

Over 100 rotary drilling taper joints reduced to 7.

Two hundred different sizes and styles of derricks reduced to 11.

Fifteen to 20 different sizes of rig irons reduced to 3.

Twenty to 30 different sizes of sucker rods reduced to 3.

Standards have been set up on boilers, belting, wire rope, and manila cordage to insure uniform grades of material. Specifications are being formulated on steel storage and production tanks.

Development and Production Engineering

At the last annual meeting of the American Petroleum Institute, held in Chicago in December, 1927, the board of directors authorized the creation of the Division of Development and Production Engineering. Subsequently this division has been organized throughout the oil-producing districts and a semi-annual conference was held in Colorado Springs in June in conjunction with the semi-annual conference of the Standardization Division.

The primary objective of the division is the collection, correlation, and dissemination within the industry of information both technical and practical concerning development and production technique. The dissemination of this information is through regional meetings and through open session meetings of the American

Petroleum Institute and through the official publications of the Institute.

Research

The petroleum industry, which has grown to its great magnitude from an inadequate foundation of fundamental knowledge regarding the raw material on which it rests, has embarked on a research program designed to assist in placing methods of production and utilization upon a firmer scientific basis.

Fellowships for thirty research projects covering problems in chemistry, physics and geology are to be distributed among seventeen universities and governmental laboratories during the next year by the American Petroleum Institute, which is directing the investigations on behalf of the oil industry. John D. Rockefeller established a fund of $250,000 for the work in 1926, and a like amount was advanced later by the Universal Oil Products Company. The program launched on July 1 marked the beginning of the third year of the organized research.

The projects pertain to many different phases of the petroleum industry. Some of them deal with the origin of oil and with the fundamentals of oil discovery and recovery. Others have for their object the study of crude petroleum to determine what substances are present, what the physical and chemical properties of these substances are and how they react toward other substances.

Of course, much is already known about these subjects. The industry could not have grown to its present size without the accumulation of a large amount of information; but, relatively, little more than a beginning has been made.

Take, for instance, the refining division. This includes the separation of the crude petroleum into various cuts or fractions and subsequent treatment to make the finished commercial products, such as gasoline, kerosene, lubricating oil, paraffin wax and grease. Yet no one knows just what substances are present in the crude petroleum used as a raw material or in the various products.

Or consider the problem of bringing the crude petroleum to the surface of the ground. Holes are drilled to porous underground "rocks" or "sands," saturated with oil, and the oil is brought to the surface by various means. But this business is carried on under the handicap of incomplete knowledge as to how the oil originated, how it found its way to these underground reservoirs and how it can most effectively and efficiently be brought to the surface.

Additions to the sum of our knowledge of the fundamental facts about petroleum, which may result from the research, can not fail to be of great assistance in placing present-day methods upon a firmer scientific foundation and in paving the way for future developments.

Technical Activities

The Institute has for several years cooperated with the National Automobile Chamber of Commerce, the Society of Automotive Engineers, and the Bureau of Standards in conducting research in the laboratories of the Bureau on problems dealing with the utilization of gasoline and lubricants in automobiles. The results of this work have been published from time to time, and are of value to the petroleum and automotive industries and to the general public as well.

The technical division of the Institute also works closely with the American Society for Testing Materials in developing methods of tests for petroleum products. This work is centered in Committee D–2 on Petroleum Products and Lubricants, and the secretarial work of this committee is carried on at the offices of the Institute.

The Institute also cooperates with the Federal Specifications Board in preparing specifications for petroleum products purchased by the Government, through its representation on a board created to advise the Government's Technical Committee regarding the specifications that are formulated.

Corrosion Problems

General and sub-committees of the American Petroleum Institute are engaged in cooperative work looking toward the elimination or minimization of corrosion losses with respect to equipment in all branches of the industry. These committees began their work a year or so ago and a study was initiated to determine how great such losses were and to suggest ways and means by which corrosion might be combated to advantage by cooperation.

The work of these committees includes cooperation with other committees or agencies outside of the oil industry which are engaged in corrosion investigations, such as the American Society for Testing Materials, the United States Bureau of Mines and the United States Bureau of Standards.

Fire Prevention and Protection

Through the committee of Fire Protection and Prevention the American Petroleum Institute has engaged in encouragement and cooperative activities for the prevention of fires and is also interested in safeguarding the industry against ill-advised and unwarranted fire-prevention legislation and regulation. It is in cooperative contact and relationship with such national agencies as the National Fire Protection Association, the National Board of Fire Underwriters, the International Association of Fire Chiefs, etc.

Safety

The Institute has cooperated with the National Safety Council and its petroleum division, and recently the Institute's activity and relation to safety in the oil industry has been considerably enlarged.

Oil Pollution

At the annual meeting of the American Petroleum Institute in December, 1926, the Board of Directors resolved that the president of the Institute appoint committees to investigate oil pollution conditions in the United States and initiate remedial measures and report their findings to the president, the theory being that evils of pollution could be remedied more effectively by cooperation from within the industries than by legislation from without.

In compliance with the above resolution, E. W. Clark, president, appointed 81 representatives from 51 oil companies on committees to carry out this survey. In addition, 75 to 100 employes of these companies participated in this survey. These representatives, who were for the most part experienced engineers, visited a total of 619 oil plants and a total of 177 oil fields.

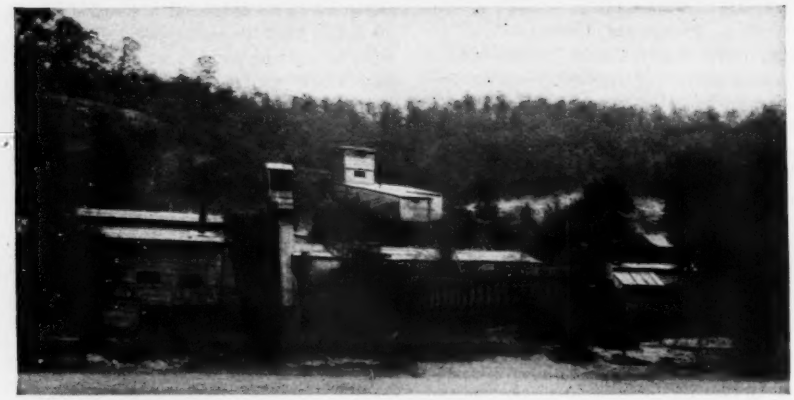
The management of these plants cooperated to the fullest extent with the committees. This cooperation was not confined to a mere extending of courtesy alone but also included a sincere effort on their part to place before the committees a true picture of conditions as they really existed, frequently going to the length of pointing out their own deficiencies.

The report covering the survey of oil pollution conditions in the United States with remedial measures recommended by the committees appointed by the American Petroleum Institute was submitted to the Board of Directors in December, 1927.

The interest and cooperation of the oil industry as indicated by this survey demonstrates its willingness to adopt every practical precaution to guard against the pollution by oil of the navigable waters and their tributaries in the United States.

Railroad Transportation

Through appropriate committees, the industry's multitude of problems affecting the transportation of petroleum and its products by railroad—except freight rates—are considered. Cooperative relationship with various divisions of the American Railway Association exists, notably the Transportation and Mechanical Divisions, which more directly affect the industry's activities in relation to tank-car construction and the rules and regulations cov- (*Continued on page* 691)



DEVELOPMENTS *in* MANGANESE *the*

By J. CARSON ADKERSON *

THROUGH the encouragement of the tariff, developments of manganese in the United States, during the past few years, have proceeded as never before in history. Recent increases in reserves of both high and low grade ores and the inauguration of new and successful processes in the beneficiation of low grade ores, formerly considered of no value, give assurance of a domestic production sufficient to guard the security of the nation in an emergency and promise eventually to make the United States independent of foreign sources of supply.

Montana has, since 1917, led all states in the production of high grade manganese ore. The reserves in Montana have properly been estimated to run into millions of tons. The Domestic Manganese and Development Company, with a production capacity rated at 300 tons per day of ore running 57 percent metallic manganese, serves to open the eyes of our country to the possibilities in the beneficiation of our low grade ores. This company is engaged in nodulizing rhodocrosite ores of the Butte district drawn from properties of the Anaconda Copper Mining Company, the Butte Copper and Zinc Company and the Clark Montana Realty Company.

The ores in the Philipsburg district have already established themselves in

* President, American Manganese Producers Association.

Top—Mine of U. S. Manganese Corporation, Augusta County, Va. Upper center—Mining operations. Lower center—Concentration plant, Miller & Rinehart, manganese producers, Batesville, Ark. Bottom—Moorlight Mining Company mill near Philipsburg, Mont.

RECENT Increases In Reserves Of Both High And Low Grade Ores, And The Results Obtained Through Beneficiation Of Low Grade Ores, Gives Promise Of An Industry That Will Eventually Make This Country Independent Of Foreign Sources Of Supply—A Review Of Recent Developments In Manganese Production

PRODUCTION *in* UNITED STATES

Upper — Pit, Evergreen Mining Company, Ironton, Minn. Lower—Face of solid ore in manganese ridge, Hy Grade Manganese Company, Woodstock, Va.

the world's markets. Manganese shipped by the Trout Mining Company and the Moorlight Mining Company has supplanted foreign ores in the manufacture of dry cell batteries. The development and production of steel ore from the Philipsburg field is in its infancy. Increase in developments and shipments of both steel and battery ore is sure to come. The known reserves of the district and the high quality and grade of the ore is bound to bring the extensive development which the field rightfully deserves.

Shipments of ore from the Butte and the Philipsburg districts of Montana speak for themselves as to the value of these deposits in the manganese industry. Developments going forward in Montana will be a large factor in making the United States independent of foreign sources of supply.

Minnesota reports sufficient ore with a manganese content, which when recovered will, alone, supply the needs of the United States for more than half a century. A conservative estimate of this ore, which it is claimed may be recovered, is put in excess of 100,000,000 tons. The present production of manganiferous iron ore in Minnesota is approximately 1,000,000 tons a year.

In New Mexico, the Silver Spot Mines at Silver City, and other operators in that territory have an annual production of 40,000 tons of manganiferous ore. Near Deming, New Mexico, R. H. West has for some time been engaged in a substantial development for the production of high grade ore. Recently the Luna Manganese Company has undertaken considerable development in this same district. This company is now preparing to install a milling plant and also to extend their mining operations.

In the Batesville, Ark., district Miller and Rinehart have been engaged in explorations and in working out methods of treatment for low grade ores. This district alone claims an excess of 30,000,000 tons of manganiferous ore from which manganese may be profitably recovered.

The Georgia Minerals Company, with holdings near Cartersville, is prepared to ship 20,000 tons of ferro grade ore, annually, with assurance of increased shipments as conditions may warrant. The Etowah Development Company and others in the Cartersville district have deposits of considerable extent and promise to enter the ranks of actual production.

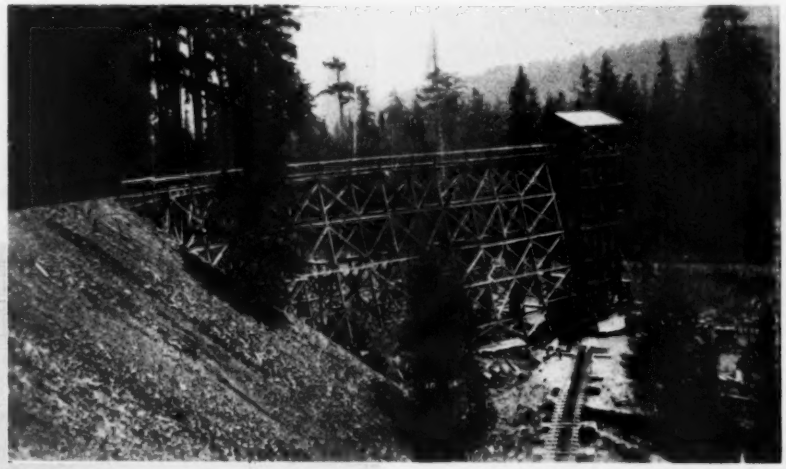
In Virginia, where the first manganese ore in the United States was mined, in 1832, the Hy-Grade Manganese Company, actively engaged in mining Oriskany manganese deposits, is making ready to market 30,000 tons of high grade ore. This company has over 6,000 feet of tunnel and shaft development and has blocked out reserves of several hundred thousand tons of ore. The United States Manganese Corporation, in Augusta County, is developing a deposit similar to the famous Crimora Basin. Open cut and tunnel operations are in progress and a milling plant has been erected. A considerable part of a large basin has been drilled over, proving ore to a depth of 150 feet. Drilling is still in progress developing additional reserves and preparations are being made for production. The Virginia Manganese and Mining Company and the Dunn Manganese Company, in Southwest Virginia, are engaged in development and production of high grade ore. The Old Dominion Mining Company is drilling on an extension of the Old Crimora Basin and developing reserves of high grade ore.

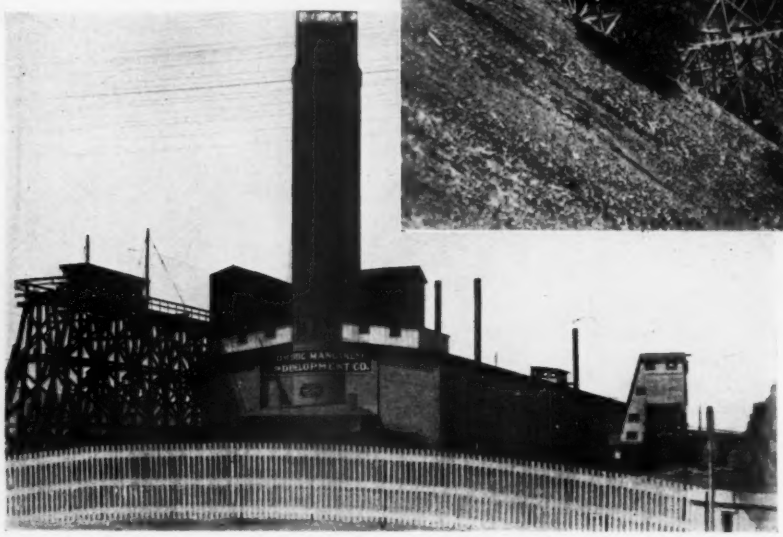
In Gunnison County, Colo., the Manganese Mines Company of America is engaged in developments which promise a considerable tonnage, some of this ore being of chemical grade.

Contrary to previous reports, which claimed that the Crescent Mine, in Washington State, had been exhausted, a new 1,000-ft. tunnel has just recently struck ore at a low level below the old workings. The Washington Manganese Mining Company is making ready to ship a product running 52 to 54 percent manganese. Large deposits of low grade ores are known to exist in the Olympic

Mountains and these ores can be made available through beneficiation. Development is under way in both low and high grade ores.

Developments in high grade ore, or research in beneficiation of lower grade ores, of more or less importance, are under way on deposits in Tennessee, North Carolina, Alabama, Idaho, Arizona, Nevada and New Jersey. Manganese deposits are known to exist in California, Oregon, Oklahoma, Wyoming, Texas, Utah, West Virginia, Massachusetts and South Dakota.





Above—Washington Manganese Mining Company, near Seattle, Wash. Left—Domestic Manganese and Development Company, Butte, Mont.

In addition to the present mining operations in localities where high grade ores exist, methods for beneficiation of low grade ores have passed the experimental stage and several plants either have been completed, or, are in the process of erection for commercially treating the low grade ores. Notable among the processes evolved for the profitable treatment, by beneficiation, of ferruginous ores, is the Bradley process, which is based on leaching with sulphate of ammonia. The results of this process are so satisfactory that approximately $200,000 have been invested in its development and practical application for recovery of manganese from low grade ores.

In almost every section of the United States where manganese exists, there is unprecedented activity in the development of the mineral and one need not be an optimist to foresee the time, in the near future, when the major portion of American needs for this essential mineral may be supplied from American mines.

Mark the words of the eminent British metallurgist, Sir Robert Hadfield, quoting an ancient Chinese proverb: "They who own the iron of the world, rule the world." He adds, "It would also seem safe to say that they who own the manganese of the world have largely in their hands the control of steel of satisfactory quality such as is now necessary to meet modern requirements." It is evident from a study of the manganese situation that the operators of America, who are investing hundreds of thousands of dollars in the development of the manganese reserves of the country, are accomplishing more for preparedness and national security than those who cry we have no manganese and we can not develop an industry at home. It takes years and dollars to develop a reserve and years and dollars to perfect and apply a process, but the work of the pioneer has blazed the way and the rewards serve as a safeguard to the Nation.

J. Carson Adkerson

It is needless to say that the development in manganese will proceed and that the United States will soon have a dependable industry sufficient to meet its requirements.

MANGANESE PRODUCERS TO MEET IN WASHINGTON, D. C.

THE state of the manganese industry and recent developments in the treatment of manganese will be among the important subjects to be considered at the first annual meeting of the American Manganese Producers' Association to be held in Washington, D. C., September 10 and 11.

Carl Zaffe, of Brainerd, Minn., will speak on manganese reserves; T. L. Joseph, superintendent of the Minneapolis Experiment Station of the Bureau of Mines, will tell of the work of the station in treating manganiferous iron ores; J. S. Grasty will speak on types of deposits of manganese in Virginia; Dr. Oswald Schriener, of the Kentucky Bureau of Mines, is scheduled for an address on the use of manganese as a fertilizer; and a representative of the Anaconda Copper Mining Company will speak on rhodocrosite ore. D. F. Hewett, Geological Survey, will discuss methods of treatment of manganese.

A banquet will be held the evening of September 10. Among the speakers will be Maj. Roger W. Taylor, who will talk on "Strategic Minerals."

Harris & Ewing

LEGISLATIVE REVIEW

WHEN Congress reconvenes December 3 for the last session of the Seventieth Congress it will have before it a large number of legislative proposals which were left over from the recent session which ended May 29. The forthcoming session will be a short one, terminating March 4 when the new President and Vice President, to be elected in November, will take office. Because of a change in control of the Government from an old to a new President and a desire to allow the new President to recommend the legislative program, congressional leaders will feel inclined to pass over until the first session of the Seventy-first Congress all legislation of national importance. Unless the new President calls an extra session the regular session of the Seventy-first Congress in the new administration will not convene until December, 1929. Vice President Charles G. Dawes will serve his last session as presiding officer of the Senate during the coming winter as he was not renominated.

Session Of Congress Beginning In December To Mark Clean-Up Of Pending Legislation—Mining Bills Await Action—Numerous Investigating Committees To Report—Coal Recommendations From Committee May Be Modified By Action Of Union In Abandoning Jacksonville Wage Scale

POWER DEVELOPMENT

At the coming session the principal business to be transacted by Congress will be the passage of bills making appropriations for the Government service for the year beginning July 1, 1929. The Senate will take up as its unfinished business the bill which has already passed the House for power development on the Colorado River and the debate over Government vs. private control of business will be renewed. Action of the Senate on the measure will be influenced by a report to be made by a board of engineers and geologists on the safety, economic and engineering feasibility and adequacy of proposed structures and works involved in the project. Upon disposition of this bill, the Senate is slated to consider another measure which has been passed by the House, to subject to the laws of the States into which shipped, goods mined or manufactured by convict

labor. A committee of the House is investigating and will report on methods to dispose of prison-made goods without competition with free labor.

Mine Depletion

Considerable legislation of interest to the western mining industry is pending before Congress and may be acted on at the coming session. The most important matter is that concerning depletion allowances under the internal revenue laws to metal and coal mines. At the last session consideration was given to a proposal to allow a depletion rate of 15 percent of gross income to metal mines and 6 percent to coal mines, but action was deferred pending further consideration of the matter by officials of the Treasury Department and the Joint Congressional Committee on Internal Revenue Taxation. When the matter was laid aside last spring by the Senate Finance Committee there was an understanding that effort would be made by the Government officials and congressional tax experts to reach an agreement on the depletion rates so that they might be considered at an early session of Congress. It is likely that should another tax simplification bill come before Congress at the next session, this matter of metal and coal mine depletion will be taken care of. Another matter in committee is a proposal to exempt income from gold mining from Federal taxation.

Tariff legislation is not likely to be considered at the coming session but in the following session a tax revision bill may be taken up. For some years Michigan copper producers have been urging a duty of 6 cents per pound on imported copper and have been supported by Arizona interests. Another pending tariff proposal is for a duty of $3 per ton on feldspar.

Encouragement of development of gold production in the southern states is being sought in Congress by means of a bill to establish an assay office at Dahlonega, Ga., on the theory that it will encourage prospecting. This bill is before the House on report of its Coinage Committee. Another bill affecting assay offices is before Congress in the form of a measure to subject officials of these offices to civil service tests. They are now appointed by the President. Agitation for a change in the system of gold values by basing them on commodity prices will be renewed before the House Banking Committee, which has held hearings on these proposals. Another subject involves the revival of the former Senate Gold and Silver Commission by authorizing the Senate Mines and Mining Committee to bring down to date its reports on European currency and foreign exchange.

Western mineral producers are interested in pending legislation to amend the original war mineral relief act so as to allow for the settlement of claims in connection with the purchase of property and interest on borrowed capital and for appeal from decisions of the Interior Department in war mineral cases to the Court of Claims. The Senate has passed a bill for court review and the measure is on the House calendar subject to consideration. The bill allowing claims for purchase of property and interest is before the House Mines and Mining Committee. Under a Senate resolution the Interior Department will report on departmental rulings used in passing on war mineral cases, which will be taken as a basis for pressing the new war mineral relief bill.

Mine Funds

Western mining men in Congress will renew with vigor their appeals for greater appropriations for the Bureau of Mines. Bills to this effect are pending in House and Senate committees, and additional measures provide for a number of new mining experiment stations and mine rescue stations, among them experiment stations at Salt Lake, New Brunswick, N. J., and Bartlesville, Okla., and mine rescue stations at Spadra and Fort Smith, Ark., Terre Haute, Ind., Madisonville, Hazard, Jenkins, and Pikeville, Ky.

A large number of mining development bills are pending before the Senate and House or its committees. These include measures to patent 640-acre tracts of land containing gold, silver, lead, tin or copper at depth; changing the method of patenting mining claims; authorizing prospecting permits and leases to gilsonite; to develop processes for the recovery of potash; for the marking of platinum; 10-year mining leases on Indian lands; adjustment of damages to lands by pollution from oil and gas wells; prohibiting the pollution of streams by mine drainage; and amending the law regarding sodium royalties to the Government.

Blue Sky

Bills proposing to regulate the issuance and sale of mining and other securities are pending before congressional committees, but are not likely to receive active consideration because of the short session and the pronounced opposition to such regulation. The Federal Trade Commission is investigating the blue sky situation and Congress will no doubt await its report and be guided by its recommendations in connection with legislative proposals along these lines.

A number of public land measures are also awaiting action. These include bills to permit holders of mining claims in Alaska to pay the cost of annual assessment work on their claims instead of performing this work; granting lands in Alaska for the support of its School of Mines; road improvements in mining districts in Alaska; to cede the unreserved public lands to the states; and to grant patents to 160-acre tracts of land which have been held under claim or color of title for more than 20 years.

Coal Measures

While coal legislation will undoubtedly be again agitated, Congress is unlikely to pass any legislation at the coming session on this question. It would take more than the three months of the session to put a bill through all of the various legislative states in the House and Senate and it is uncertain that the committees considering this matter could muster enough votes to report out a measure. This was demonstrated two years ago when the House Interstate Commerce Committee did not secure enough votes to report out a measure. The coal situation and the attitude of Congressmen toward its consideration is expected to be influenced by the recent action of the miners union in conceding that the Jacksonville wage agreement was uneconomic and incapable of operation. The investigation of the coal situation at the last session by the Senate Interstate Commerce Committee largely revolved around this wage agreement, it being charged by the union that idleness and trouble in the coal fields had been brought about by the action of certain operators in declining to continue operations under that scale. To interested observers it appears that the force behind the movement for legislation has been weakened by the decision of the union to permit its district unions to negotiate wage scales with the operators as such action will automatically result in the operation of the mines under conditions affecting each district and there will be no occasion for uniformity of action by the union and operators.

The Senate Committee on Interstate Commerce recessed its consideration of the coal situation in May until the coming session after having received only one legislative proposal and that from the miners' union, largely treating with labor relations. Senator Watson, Republican, Indiana, introduced this union bill for discussion. Since the hearings closed Senator Gooding, Republican, Idaho, who was one of the leaders in the investigation, and who inspected conditions in Pennsylvania, has died, which fact will have a material bearing on the future deliberations of the committee as the Idaho Senator was the only Republican member on the committee who took a pronounced view against the operators. There are a large number of other coal measures before the House and Senate, but if the Senate Committee decides to take up the question actively it is expected that Senator Watson's bill will be the basis for its consideration. It is

recognized in many quarters that there may be difficulty in having Congress amend the anti-trust law to permit consolidations in the bituminous industry as has been proposed. The anti-trust law has been in effect for nearly 40 years, during which time it has been subject to but very few changes, the principal one being during the war to exempt labor from its operation. Other coal bills pending are to establish standards of quality for anthracite and for the purchase by the Government of coal deposits of the Choctaw and Chickasaw Indians in Oklahoma.

Congressional committees have been struggling with legislation designed to curb alleged abuses of Federal courts in issuing injunctions in labor disputes. In hearings both before the Senate Interstate Commerce Committee in the coal investigation and the Judiciary Committee, injunctions issued in cases involving the protection of coal mines have been considered. There has been an expression of opinion by some members of these committees that the right to enjoin should be continued for the protection of life and property and it has been admitted that it will be difficult to revise the law to meet the objections to injunctions and at the same time preserve the right to enjoin in proper cases.

Oil bills pending include measures to prescribe procedure regarding contests of claimants to oil and gas permits; to reduce the acreage to be leased or suspend oil leases on the Osage Indian Reservation in Oklahoma in case of overproduction or inadequate prices for oil, and for operation and conservation of oil and oil shale reserves by the Navy.

Mexican Immigration

While proposals to restrict immigration from Mexico, Canada, and other countries of the western hemisphere have been pending they are not likely to be acted on during the coming session. Diplomatic relations are involved in this question as it is feared that Mexico might become offended should the United States bar its citizens. The fact that some of the southern border states were at one time Mexican territory is also a factor in the situation, and it has been reported that the American Federation of Labor has agreed to refrain from taking action on the question under an agreement with the Mexican Federation of Labor by which Mexico would discourage its citizens from crossing the border.

Transportation measures before Congress include bills to require the use of steel cars in the railway postal service; consolidation of railroads; forbidding railroads from charging a greater amount for a short haul than for a long haul in the same direction; reducing railroad freight rates to the schedules in effect in February, 1920; repealing the act authorizing a general readjustment of freight rates; establishment of freight rates based on cost of service, and regarding extensions or abandonment of new lines of railroad. Patent legislation pending includes bills for determination of cases involving patent rights by the Court of Customs Appeals; for forfeiture of patents on conviction of monopoly under a patent; to license patents owned by the United States; and for the compulsory licensing of unused patents.

Investigations

In addition to investigations before mentioned, the following inquiries are being conducted by Government bureaus or Congressional committees by direction of Congress:

Cost of production of tungsten in United States and China; naval oil reserve leases; legality of oil leases in the Salt Creek field in Wyoming; electric power industry; Indian affairs; unemployment; diversion of commerce from American to Canadian ports; national parks; public lands in northern Minnesota.

In addition to these inquiries, proposals are pending before Congress for further investigations. These would cover freight rates on bituminous from Pennsylvania, Ohio, West Virginia, Virginia, Kentucky and Tennessee; pollution of rivers in Pennsylvania and Ohio; violation of law by oil companies in Arizona; concessions by oil companies abroad; patent procedure; charges by the Western Electric Company for materials; aluminum and other household articles; and improvement of the Cape Cod Canal in Massachusetts.

Based on past records, very few of the bills pending before Congress will become a law. During the last session only 15 important laws of special interest to mining were enacted. They were:

Laws Enacted

H. R. 1. Reducing Federal taxes to the extent of $225,295,000 annually. Corporation tax rate cut from 13½ to 12 percent.

S. J. Res. 38. Authorizing New Mexico to lease minerals in lands granted to the state by Congress June 20, 1910.

S. 4135. Withdrawal of 7,000 acres of public land in the Angeles National Forest from location and entry under the mining laws for the purpose of conserving water and forest resources in Los Angeles County, Calif.

H. R. 8126. Prohibiting the killing of game for food by prospectors and miners in Mt. McKinley National Park, Alaska, but allowing the right to prospect for minerals in the park.

S. 3365. Authorizing mining leases to land of Indians on the Shoshonee or Wind River Reservation in Wyoming.

S. 3594. Extending the restriction on lands of the Five Civilized Tribes of Indians in Oklahoma for 25 years from April 26, 1931, and subjecting minerals produced after that date on these lands to state and Federal taxation.

S. 4448. Subjecting to taxation by Oklahoma, lands of the Five Civilized tribes of Indians in excess of 160-acre holdings after April 26, 1931.

S. 3593. Authorizing the lease or sale of lands reserved for administrative purposes for the Fort Peck Indians in Montana.

H. J. Res. 318. Directing the Interior Department to withhold approval of adjustment of land grants to the Northern Pacific Railroad, which involve classification of mineral lands, until June 30, 1929, to enable the Joint Congressional Commission which has been investigating the grant to report its recommendations.

S. 1455. Allowing a two-year extension of coal prospecting permits under the leasing law.

S. 3867. Extending existing developed coal mining leases and the time for their payment on lands of the Choctaw and Chickasaw Indians until September 25, 1932.

H. R. 5783. Extending for two years oil prospecting permits under the leasing law.

H. J. Res. 292. Inviting the states and foreign countries to participate in an international petroleum exposition at Tulsa, Okla., beginning October 20.

S. 1959. Transferring jurisdiction over leases in the naval oil reserves from the Interior Department to the Navy Department.

Pending Legislation

The following is a summary of bills pending before Congress or its committees which are subject to action at the coming session:

A 15 percent depletion rate for metal mines and a 6 percent rate for coal mines. This matter was considered in connection with the recent tax law but was postponed to permit the Treasury Department to make further investigations. House Ways and Means and Senate Finance Committees.

H. R. 5546. Mr. Englebright (Rep., Calif.). To exempt income from gold mining from Federal taxation. Ways and Means.

Tariff

H. R. 8829. Mr. James (Rep., Mich.). A duty of 6 cents per pound on imported copper. Ways and Means.

H. R. 6860. Mr. Williamson (Rep., S. Dak.). A duty of $3 per ton on imported crude feldspar. Ways and Means.

H. R. 5715. Mr. Vinson (Dem., Ga.). To admit calcium arsenate free of duty. Ways and Means.

H. R. 10758. Mr. Ayres (Dem., Kans.). To reduce duties on copper, iron, steel,

and aluminum products. Ways and Means.

H. Res. 77. Mr. Hull (Dem., Tenn.). To repeal duties on iron and steel articles. Ways and Means.

H. R. 12993. Mr. Hull (Dem., Tenn.). To repeal a provision of the tariff law authorizing duties on coal, calcium, cyanimid, brick, cement, gunpowder, sporting powder, and other explosive substances to equalize duties imposed by foreign countries on imports of these products from the United States. Ways and Means.

Currency

H. R. 12451. Mr. Bell (Dem., Ga.). To establish an assay office at Dahlonega, Ga. Reported by the Coinage Committee.

S. 4549. Mr. George (Dem., Ga.). Similar to the foregoing. Mines and Mining.

H. R. 13998. Mr. Welch (Rep., Calif.). To place assayers of mints and assay offices under the classified civil service. Civil Service.

H. R. 124. Mr. Burtness (Rep., N. Dak.), and H. R. 11806, Mr. Strong (Rep., Kans.). To base the value of the dollar on commodity prices. Banking and Currency.

S. Res. 95. Mr. Copeland (Dem., N. Y.). Authorizing the Mines and Mining Committee of the Senate to revise prior reports of the Senate Gold and Silver Commission on foreign exchange and European currency. Reported by Mines and Mining Committee and referred to Expenses Committee.

Mining

H. R. 8302. Mr. Colton (Rep., Utah), and S. 713, Mr. King (Dem., Utah.). Authorizing patents to 640 acre tracts of land containing gold, silver, cinnabar, lead, tin or copper at depth. Public Lands.

S. 715. Mr. King (Dem., Utah). To amend Sections 2325 and 2326 of the Revised Statutes prescribing the methods of obtaining patents to mining claims, by authorizing the issuance of patents by the courts. Public Lands.

H. R. 68. Mr. Colton (Rep., Utah.) Authorizing prospecting permits and leases for gilsonite on public lands. Reported by House Committee on Public Lands.

H. R. 496. Mr. Winter (Rep., Wyo.). Expenditure of $200,000 over a period of four years by the Bureau of Mines and Bureau of Soils to develop processes for the recovery of potash. Passed by the House.

S. 1347. Mr. Oddie (Rep., Nev.). Appeals by war mineral claimants to the Court of Claims. Passed by the Senate, and reported by the House Committee on Mines and Mining.

H. R. 11411. Mr. Winter (Rep., Wyo.). Similar to the foregoing. Reported by the House Committee on Mines and Mining.

H. R. 14131. Mr. Timberlake (Rep., Colo.). Authorizing the payment to war mineral claimants of losses in connection with the purchase of property and interest on borrowed capital. Mines and Mining.

The Senate passed a resolution offered by Senator George (Dem., Ga.), calling on the Secretary of the Interior for copies of rules and regulations used in administering the war mineral relief act and opinions thereunder on legal questions involved by war mineral relief commissions, solicitors of the Interior Department and the Attorney General.

S. 1251. Mr. Watson (Rep., Ind.). For the marking of platinum imported into the United States or transported in interstate commerce. Passed by the Senate.

H. R. 5639. Mr. Parker (Rep., N. Y.). Similar to the foregoing. Interstate Commerce.

H. R. 479. Mr. Winter (Rep., Wyo.). Granting oil and gas prospecting permits and leases to lands in Wyoming. Reported by the House Committee on Public Lands.

S. 767. Mr. Warren (Rep., Wyo.). Similar to the foregoing. Public Lands.

S. 1502. Mr. Wheeler (Dem., Mont.). Ten year mining leases on Indian lands. Indian Affairs.

H. R. 356. Mr. Winter (Rep., Wyo.). Ten year extension of time for making entry and payment for mineral lands under the act of March 3, 1905. Passed by the House and reported by the Senate Indian Committee.

H. R. 404. Mr. Garber (Rep., Okla.). To repeal that part of the stock raising homestead act which reserves to the Government the coal and other minerals in the land. Public Lands.

H. R. 353. Mr. Williams (Dem., Tex.). To allow world war veterans to have title to coal and minerals in their stock raising homestead land entries. Public Lands.

H. R. 8927. Mr. Newton (Rep., Minn.). Authorizing combinations in potash and other raw materials to meet foreign competition. Defeated by the House.

S. 2727. Mr. Thomas (Dem., Okla.) and H. R. 9294, Mr. Howard (Dem., Okla.). For adjustment of damages to crops or improvements by pollution from oil and gas wells under leases on the Osage Indian Reservation in Oklahoma. Indian Affairs.

H. R. 12065. Mr. Garrett (Dem., Tenn.). Creating a Department of Conservation, one of whose duties would be the elimination of pollution of streams. Executive Departments.

H. R. 9282. Mr. Tatgenhorst (Rep., Ohio). To prohibit the pollution of streams by mine drainage. Rivers and Harbors.

H. R. 10885. Mr. Arentz (Rep., Nev.). Amending the leasing law by reducing the royalty to the Government under sodium leases to 2 percent of the output instead of one-eighth of the value of the production. Passed by the House and Senate.

S. 3949. Mr. Oddie (Rep., Nev.). That coal and other minerals shall not be withdrawn from entry on lands which have been or may hereafter be withdrawn for livestock watering purposes. Passed by the Senate.

H. R. 12520. Mr. French (Rep., Idaho). Authorizing the Court of Claims to pass on claims of the Nez Perce Indians of Idaho for gold mined on their land before the treaty of June 9, 1863. Indian Affairs.

H. R. 13407. Mr. Leavitt (Rep., Mont.). Reserves minerals on the Osage Indian Reservation to the Osage Indians until April 8, 1958, or as long thereafter as oil, gas, or other minerals are found in paying quantities. Not more than 25,000 acres of the land may be leased for oil and gas in any one year. For arbitration of damages caused by pollution of streams by oil and gas wells. Indian Affairs.

S. 4158. Mr. Wagner (Dem., N. Y.). Collection monthly by the Department of Labor of statistics as to changes of employment in industries, including the number employed, total hours of employment, and wages paid in the mining, manufacturing and transportation industries. Appropriates $100,000 annually. Labor.

H. R. 393. To take a census of mines and distribution in 1930 and each ten years thereafter. Passed by the House.

H. R. 10140. Mr. Bloom (Dem., N. Y.). An exposition of mines and other industries at Brooklyn, N. Y., in 1932, in celebration of the 200th anniversary of the birth of George Washington. Foreign Affairs.

H. R. 20. Mr. Denison (Rep., Ill.). To regulate the sale of securities. Interstate Commerce.

H. R. 11462. Mr. Dempsey (Rep. N. Y.). Similar to the foregoing. Judiciary.

H. R. 5761. Mr. Zihlman (Rep., Md.); H. R. 12731, Mr. Denison (Rep., Ill.); S. 1905 and S. 3901, Mr. Capper (Rep., Kans.). To regulate the sale of securities in the District of Columbia. Committee on District of Columbia.

H. R. 5607. Mr. McClintic (Dem., Okla.). To regulate the issuance of securities under a license system conducted by the Federal Trade Commission. Interstate Commerce.

S. 2079. Mr. Oddie (Rep., Nev.) and H. R. 11531, Mr. Englebright (Rep., Calif.). Additional annual appropriation of $448,000 for experiment stations of the Bureau of Mines. The Senate bill was reported by the Senate Mines and Mining Committee and referred to the Appropriations Committee. The House bill is before the House Mines and Mining Committee.

S. 1330. Mr. Smoot (Rep., Utah.). Appropriation of $1,000,000 for a plant at Salt Lake City for investigations by the Bureau of Mines. Mines and Mining.

S. 708. Mr. King (Dem., Utah). To appropriate $500,000 for a plant for investigations by the Bureau at Salt Lake City. Mines and Mining.

H. R. 12992. Mr. Hoffman (Rep., N. J.). Appropriation of $250,000 for a plant for investigations by the Bureau of Mines at New Brunswick, N. J. Mines and Mining.

S. 4017. Mr. Thomas (Dem., Okla.) and H. R. 12771, Mr. Howard (Dem., Okla.). Appropriating $500,000 for a plant for investigations by the Bureau of Mines at Bartlesville, Okla. Mines and Mining.

H. R. 13399. Mr. Howard (Dem., Okla.). Appropriating $25,000 for an experiment station of the Bureau of Mines at Bartlesville, Okla. Mines and Mining.

H. R. 5651. Mr. Ragon (Dem., Ark.). Mine rescue station and car at Spadra, Ark. Mines and Mining.

H. R. 7945. Mr. Wingo (Dem., Ark.). Mine rescue sattion at Fort Smith, Ark. Mines and Mining.

H. R. 6484. Mr. Johnson (Rep., Ind.). Mine rescue station at Terre Haute, Ind. Mines and Mining.

H. R. 5811. Mr. Kincheloe (Dem., Ky.). Mine rescue station and car at Madisonville, Ky. Mines and Mining.

H. R. 9680, H. R. 9681 and H. R. 10361. Mrs. Langley (Rep., Ky.). Mine rescue stations at Hazard, Jenkins, and Pikeville, Ky. Mines and Mining.

Alaska Minerals

(Introduced by Mr. Sutherland, Rep., Alaska.)

H. R. 339. Permitting holders of mining claims in Alaska to pay the amount of the annual assessment work on their claims instead of performing the assessment work. Passed by the House.

H. R. 331. Extending the United States mining laws to land on Annette Island, Alaska. Public Lands.

H. R. 10157. Granting 100,000 acres of land in Alaska to the Agricultural College and School of Mines of Alaska. Passed by the House.

H. J. Res. 48. Appropriating $750,000 for road improvements in mining districts in Alaska. Territories.

Public Lands

H. R. 477 and H. R. 5740. Mr. Winter (Rep., Wyo.). To cede unreserved public lands to the states. Public Lands.

S. 3776. Mr. Nye (Rep., N. Dak.). To grant patents to 160 acre tracts of public land which have been held under claim or color of title for more than 20 years on payment of not less than $1.25 per acre. Passed by the Senate and reported by the House Public Lands Committee.

H. R. 13899. Mr. Michener (Rep., Mich.). Similar to the foregoing, except that it applies only to public land in Michigan. Public Lands.

Coal

S. 4490. Mr. Watson (Rep., Ind.), and H. R. 13880, Mr. Rathbone (Rep., Ill.), (since deceased). Creating a bituminous coal commission to supervise consolidations and cooperative marketing arrangements under a licensing system in the bituminous coal industry. Interstate Commerce.

H. R. 12105. Mr. England (Rep., W. Va.). Authorizing consolidations in the mining and marketing of bituminous. Judiciary.

H. R. 8523. Mr. Jacobstein (Dem., N. Y.), and S. 2029, Mr. Copeland (Dem., N. Y.). To exempt consolidated companies in the production and distribution of bituminous from the anti-trust law under supervision of the Department of Commerce, and to regulate the assignment of cars to new mines. Interstate Commerce.

S. 800. Mr. Copeland (Dem., N. Y.). Creating the Bureau of Mines as a fact-finding agency for the coal industry, for appointment of boards to adjust labor disputes in coal mining, and for emergency Federal fuel control. Labor.

H. R. 8321. Mr. Boylan (Dem., N. Y.). Government operation of anthracite and bituminous mines in emergencies. Interstate Commerce.

S. 2826. Mr. Brookhart (Rep., Iowa). Government operation of the anthracite industry under an appropriation of $50,000,000. Interstate Commerce.

H. J. Res. 100. Mr. Berger (Soc., Wis.). Government operation of the bituminous industry. Interstate Commerce.

H. R. 13408. Mr. Berger (Soc., Wis.). Creates a Federal public service commission to operate coal mines and oil and gas wells. Appropriates $500,000,000. Interstate Commerce.

S. 676. Mr. Robinson (Dem., Ark.); H. R. 92, Mr. Kelly (Rep., Pa.); H. R. 262, Mr. O'Connell (Dem., N. Y.); H. R. 275, Mr. Oliver (Dem., N. Y.); H. R. 397, Mr. Gallivan (Dem. Mass.), (since deceased); H. R. 6671, Mr. Lindsay (Dem., N. Y.). Authorizing the appointment of boards of industrial adjustment to settle strikes in anthracite or bituminous mines. These boards would consist of the Secretaries of Labor and Commerce and the Director of the Bureau of Mines. The bills appropriate $100,000. The Senate bill was referred to the Labor Committee and the House bills to the Interstate Commerce Committee.

S. 3610. Mr. Wheeler (Dem., Mont.), and H. R. 11986, Mr. La Guardia (Rep., N. Y.). Appropriating $25,000,000 and $75,000,000 respectively for relief of striking miners. Labor and Judiciary.

H. R. 207. Mr. Luce (Rep., Mass.). To establish standards of quality for anthracite. Interstate Commerce.

H. R. 9858. Mr. Cartwright (Dem., Okla.). Appropriating $12,000,000 for the purchase by the Government of coal deposits of the Choctaw and Chickasaw Indians in Oklahoma. Indian Affairs.

Oil

S. 1512. Mr. Wheeler (Dem., Mont.). Authorizing procedure in regard to contests of claimants to oil and gas permits under the leasing law. Passed by the Senate.

H. R. 9033. Mr. Howard (Dem., Okla.), and S. 2360, Mr. Frazier (Rep., N. Dak.). To reduce the amount of acreage to be leased or to suspend leases for two years on the Osage Indian Reservation in case of over-production or inadequate prices for oil. The Senate bill was passed by the Senate. The House bill is before the House Indian Committee.

S. 832. Mr. McKellar (Dem., Tenn.). Forbidding oil or oil shale holdings in the United States by citizens of other countries whose governments deny equal privileges to Americans. Foreign Relations.

H. R. 11617. Mr. Butler (Rep., Pa.), (since deceased). For the conservation and operation of oil and oil shale reserves by the Navy. Naval Affairs.

Labor

H. R. 6848. Mr. Rathbone (Rep., Ill.), and S. 1266, Mr. Shortridge (Rep., Calif.). Creating a safety division in the Department of Labor. Reported by the Senate and House Labor Committees.

S. 4409. Mr. Reed (Rep., Pa.), and H. R. 13790, Mr. Welch (Rep., Calif.). For investigations by the Department of Labor in foreign countries. Labor.

H. R. 13901. Mr. Rathbone (Rep., Ill.), and S. 4157, Mr. Wagner (Dem., N. Y.). Creating a national employment service under an annual appropriation of $4,000,000 until June 30, 1932 of which 75 percent shall be allotted to the states for the maintenance of employment agencies. Judiciary and Labor.

H. R. 7729. Mr. Cooper (Rep., Ohio), and S. 1940, Mr. Hawes (Dem., Mo.). Subjecting goods mined or produced by convict labor to the laws of the states into which they are shipped. The House passed the House bill and the Senate bill has been reported by the Senate Interstate Commerce Committee and is slated for consideration by the Senate at the next session after the Colorado River development bill is disposed of.

H. R. 114. Mr. Blanton (Dem., Tex.). To prevent combinations of persons from restraining others from working in the coal industry. Interstate Commerce.

S. 1482. Mr. Shipstead (F. L., Minn.), and H. R. 10082, Mr. La Guardia (Rep., N. Y.). To restrict the issuance of injunctions by courts in labor disputes. Judiciary.

Power

S. J. Res. 46. Mr. Norris (Rep., Neb.). Government operation of the Muscle Shoals, Ala., nitrate and power project. Passed by Congress, but given a pocket veto by the President.

H. R. 5773. Mr. Swing (Rep., Calif.). Power development on the Colorado River. Passed by the House.

S. 728. Mr. Johnson (Rep., Calif.). Similar to foregoing. Unfinished business of the Senate.

S. 3920. Mr. Tyson (Dem., Tenn.). State control of transportation and disposition of electric energy in interstate commerce. Interstate Commerce.

S. 1710. Mr. Ransdell (Dem., La.). Creation of an hydraulic laboratory in the Bureau of Standards to study the control of waters and hydraulic structures and instruments under an appropriation of $350,000. Passed by the Senate.

Immigration

H. R. 6465. Mr. Box (Dem., Tex.) Two percent quota restriction against immigration from Mexico and other countries of the western hemisphere. Immigration.

S. 3019. Mr. Watson (Rep., Ind.). Ten percent immigration quota against Mexico. Immigration.

H. R. 10955. Mr. Allgood (Dem., Ala.), and S. 1437. Mr. Harris (Dem., Ga.). Restriction of immigration from Mexico. Immigration.

Transportation

S. 2107. Mr. Dale (Rep., Vt.). Requiring the use of steel cars in the railway postal service after January, 1930. Passed by Senate.

H. R. 9678. Mr. Kelly (Rep., Pa.). Similar to foregoing. Post Offices.

H. R. 12620. Mr. Parker (Rep., N. Y.). Railroad consolidations. Reported by Interstate Commerce Committee.

S. 1175. Mr. Fess (Rep., Ohio), and S. 3945, Mr. Brookhart (Rep., Iowa). Railroad consolidations. Interstate Commerce.

S. 4460. Mr. Brookhart (Rep., Iowa). Coast-to-coast railroad system. Interstate Commerce.

S. 1263. Mr. Gooding (Rep., Idaho). Forbidding railroads from charging a greater amount for a short haul than for a long haul in the same direction. Reported by Interstate Commerce Committee.

S. 2489. Mr. Brookhart (Rep., Iowa); H. R. 7022, Mr. Taylor (Dem., Colo.); H. R. 9191, Mr. Shallenberger (Dem., Nebr.), and H. R. 9835, Mr. Kopp (Rep., Iowa). Similar to the foregoing. Interstate Commerce.

H. R. 5716. Mr. Vinson (Dem., Ga.); H. R. 9189, Mr. Shallenberger (Dem., Nebr.), and S. 1735, Mr. Howell (Rep., Nebr.). Reducing railroad freight rates to the schedules in effect in February, 1920. Interstate Commerce.

S. 3414. Mr. Glass (Dem., Va.). Repealing the act of 1925 authorizing a general readjustment of freight rates. Interstate Commerce.

S. 3922. Mr. Glass (Dem., Va.), and H. R. 12692, Mr. Peery (Dem., Va.). Establishment of freight rates based on cost of service. Interstate Commerce.

H. R. 13113. Mr. Abernethy (Dem., N. C.). Eliminating certificates by the Interstate Commerce Commission for the construction of new lines or extension of existing lines of railroads. Interstate Commerce.

S. 2309. Mr. Mayfield (Dem., Tex.). Similar to the foregoing, applying to lines wholly in a State if the laws of the State require a certificate of convenience. Reported by Interstate Commerce Committee.

H. R. 13650. Mr. Stevenson (Dem., S. C.). Eliminating certificates of convenience by the Interstate Commerce Commission for the extension or abandonment of spur, industrial, team, switch or side tracks in a State. Interstate Commerce.

S. 742. Mr. Jones (Rep., Wash.). Establishing foreign trade zones in American ports of entry. Reported by the Interstate Commerce Committee.

H. J. Res. 321. Mr. Hill (Dem., Wash.); H. J. Res. 322, Mr. Hadley (Rep., Wash.); and S. J. Res. 165, Mr. Dill (Dem., Wash.). Authorizing the Cascade Tunnel Association to cross government lands in the construction of a tunnel for general transportation purposes under the Cascade Mountains in Washington, from Skykomish to Leavenworth through a forest reserve from King County on the east to Chelan County on the west. The House resolution was referred to the Public Lands Committee and the Senate Resolution to the Agricultural Committee.

S. 3874. Mr. Walsh (Dem., Mont.). Appropriating $1,943,200 for a highway from Red Lodge, Mont., to the boundary of Yellowstone National Park near Cooke City, Montana, which will provide transportation for mining interests. Reported by Postoffices Committee.

Patents

H. R. 6687. Authorizing the Court of Customs Appeals to hear patent appeals. Passed by the House and Senate.

S. 2783. Mr. Dill (Dem., Wash.). For forfeiture of patent rights on conviction of monopoly under a patent. Patents.

H. R. 12695. Mr. Vestal (Rep., Ind.). To license patents owned by the United States. Passed by the House.

S. 2162. Mr. Metcalf (Rep. R. I.). Similar to the foregoing. Patents.

S. 705. Mr. King (Dem., Utah). Compulsory license for unused patents. Patents.

Investigations Authorized

S. Res. 203. Mr. Oddie (Rep., Nev.). By Tariff Commission, as to differences in cost of production of tungsten in the United States and China, the principal competing country, with a view of increasing the duty.

S. Res. 105. Mr. Johnson (Rep. Calif.). By Senate Committee on Interstate Commerce, into conditions in the bituminous fields of Pennsylvania, Ohio and West Virginia under an appropriation of $20,000.

S. Res. 101. Mr. Walsh (Dem., Mont.). By Senate Public Lands Committee, into naval oil reserve leases, under appropriation of $25,000.

S. Res. 202. Mr. Robinson (Rep., Ind.). By Senate Public Lands Committee, as to the legality of oil leases in the Salt Creek field in Wyoming.

S. Res. Mr. Walsh (Dem., Mont.). By Federal Trade Commission, into capital assets, holding companies, and other phases of the electric power industry.

S. J. Res. 164. Mr. Pittman (Dem., Nev.). By board of engineers and geologists, as to the safety, economic and engineering feasibility and the adequacy of proposed structures and works involved in the Colorado River development project. This study is being made by Major General W. L. Siebert of Bowling Green, Ky., formerly of the Engineer Corps of the Army; Daniel W. Mead of Madison, Wis., formerly connected with the U. S. Geological Survey, since 1896 a consulting engineer on hydraulic works and plants, and since 1904 professor of hydraulic and sanitary engineering at the University of Wisconsin; Robert Ridgway of New York, who has specialized on engineering in connection with water works and transportation companies in New York and Chicago; Charles P. Berkey of New York, professor of geology in Columbia University since 1903, on the staffs of the Geological Survey of Minnesota, Wisconsin, and New York and a geologist on engineering and mining problems; and Warren J. Mead of Madison, Wis., professor of geology of the University of Wisconsin since 1918 and a consultant on economic and engineering geology. The board will report December 1.

S. Res. 79. Mr. King (Dem., Utah.). By Senate Indian Committee, into administration of Indian Affairs.

S. Res. 219. Mr. La Follette (Rep., Wis.). By Senate Labor Committee, as to the unemployment situation, including the effect on employment of curtailed production, consolidations, and economic reconstruction, under an appropriation of $15,000, reporting February 15, 1929.

H. R. 233. By a committee of five members of the House, consisting of Representative Cooper (Rep., Ohio), Kopp (Rep., Iowa), Taber (Rep., N. Y.), Bell (Dem., Ga.), and Boylan (Dem., N.

Y.), as to employment of prisoners in Federal and State institutions, covering the kind and amount of goods mined or produced by them, the extent to which they compete with free labor, and to report the best means by which prison-made goods can be disposed of without such competition.

S. Res. 220. By the Secretaries of State and Agriculture, the Shipping Board and the Interstate Commerce Commission, as to measures to restore the commerce of American ports which it is said is being diverted to Canadian ports.

S. Res. 237. By the Senate Public Lands Committee, as to the establishment of additional national parks and proposed changes in and boundary revisions of other national parks.

S. Res. 239. By the Senate Agricultural Committee, as to public lands adjacent to waters in northern Minnesota, looking to their reservation for forest purposes.

INVESTIGATIONS PROPOSED

S. Res. 150. Mr. Sackett (Rep., Ky.). By the Senate Interstate Commerce Committee, as to rates on bituminous from Pennsylvania, Ohio, West Virginia, Virginia, Kentucky, and Tennessee. Interstate Commerce.

H. R. 13484. Mr. Reid (Rep., Ill.). By the War Department, as to methods to remove the source of pollution of the west branch of the Susquehanna River Pennsylvania and the Auglaize, Blanchard, and Ottawa Rivers in Ohio. Passed by the House.

S. Res. 141. Mr. Ashurst (Dem., Ariz.). By the Senate Interstate Commerce Committee, as to alleged violation of law by oil companies operating refineries in California and distributing stations in Arizona. Interstate Commerce.

S. 199. Mr. King (Dem., Utah). By the Foreign Relations Committee of the Senate, as to concessions secured by the Standard Oil Company and the Gulf Refining Company in Mosul. Foreign Relations.

S. Res. 188. Mr. King (Dem., Utah). By the Senate Patents Committee, as to patent procedure. Patents.

H. R. 11353. Mr. Welch (Rep., Calif.). By the Interstate Commerce Committee, as to the reasonableness of charges by the Western Electric Company to the American Telegraph and Telephone Company for materials, under an appropriation of $40,000. Interstate Commerce.

H. Res. 123. Mr. Kindred (Dem., N. Y.). By a committee of five members of the House, as to action by the Federal Trade Commission with reference to the aluminum and other trusts dealing in household commodities. Rules.

H. R. 13086. Mr. Gifford (Rep., Mass.), and S. 4552, Mr. Gillett (Rep., Mass.). By The War Department, as to improvements to the Cape Cod Canal in Massachusetts, to accommodate present and prospective commerce. The House bill was referred to the River and Harbor Committee and the Senate bill to the Commerce Committee.

AMERICAN PETROLEUM INSTITUTE

(*Continued from page* 681)

ering their operation. Likewise all proposed Bureau of Explosive or Interstate Commerce Commission regulations are handled.

STATISTICS

The Institute collects and publishes weekly production estimates of receipts of oil at United States ports, current analyses of Government figures, changes in gross crude oil and refinery stocks, summary of California field operations, gasoline consumption by states, etc., giving members full and reliable information as to the condition of the oil industry.

PUBLIC RELATIONS

Public relations work in the oil industry is conducted under the auspices of the American Petroleum Institute and directly under supervision of the committee composed of representatives of the Institute and other oil trade associations.

PUBLICATIONS

The Institute issues a weekly bulletin to all of its members containing statistics and announcements of various kinds and also periodical bulletins for the Standardization Division and the Division of Development and Production and Production Engineering. Special statistical bulletins are issued from time to time as well as the annual meeting bulletin containing all the papers delivered at that meeting. The report of the Committee of Eleven referred to above was published in book form. Under the direction of the Public Relations Division there were Published this year "Petroleum Facts and Figures" and the "Handbook for Speakers." The Institute issues in mimeographed form a Daily Oil Digest.

PROPORTION OF MEXICAN LABORERS IN ARIZONA MINES

Representative Douglas (Dem., Ariz.) has prepared figures showing the proportion of Mexican laborers in mines in Arizona, in connection with proposed restriction of immigration from Mexico, which he opposes. The figures are for October, 1927, and show that at Bisbee 512 Mexicans, or 17 percent of the total, are employed in mines of the Calumet and Arizona Mining Company and the Phelps Dodge Corporation. Six years ago only 3 percent of the workers were Mexicans. "The wage scale has not changed, and the mining companies are still trying to get American laborers, but they are not obtainable," said Mr. Douglas. "They are not applying for work. In 1907 Bisbee was completely an American camp, with no Mexicans employed underground and a few employed on the surface. In 1905 the wage scale was $3.50 per day, and now it is $5.50, plus bonuses, making the total $7 and better a day. No distinction is drawn between American and Mexican labor.

"At Douglas, where the metallurgical works of the Calumet and Arizona Mining Company are located, there were 776 Mexicans, or 46 percent of the men employed; at Miami, 1,663 Mexicans, or 63 percent; Globe, 168 Mexicans, or 16 percent; Verde, 1,406 Mexicans, or 55 percent; Ray-Hayden, 1,119, or 65 percent; Clifton-Morenci, 604, or 50 percent; Ajo, 344, or 34 percent; and Magma, 441, or 53 percent. The totals for all these camps show 7,033 Mexicans, or 43 percent of the total of 16,162 employed.

"Globe and Bisbee mining has been controlled for 40 years by the Phelps Dodge Corporation. They have constantly attempted to maintain American camps. Up to six years ago they were relatively successful in doing so. During the last six years they have not abated their attempts to maintain American camps, but the percentage of Mexicans employed by them has increased, because American miners are no longer applying for jobs."

Mr. Douglas says the I. W. W. is not strong in these mining camps. The organization was relatively strong in 1917, when effort was made to retard the production of copper. He does not know of the existence of any I. W. W. organization in the mining regions at this time.

"If the Mexican supply of labor is shut off, these mines can not operate," said Mr. Davis.

Mr. Douglas contends that as Congress has encouraged development in the West by various kinds of legislation, it should not cut off the labor supply of industries thus created. In this connection he pointed out that Congress made lenient provisions concerning development of mineral deposits.

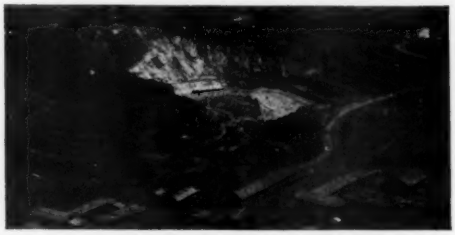
"The mines of the Southwest want Americans," said Mr. Douglas. "They do not want Mexicans, but they can not get Americans. Whenever an American goes out there to apply for a job he will get it."

Mr. Douglas stated that in time the mining regions of Arizona would be largely populated.

METALS

GUY N. BJORGE
Editor

Practical Operating Problems of the Metal Mining Industry



UNDERGROUND VENTILATION PROBLEMS *at the* COPPER QUEEN MINES, PHELPS DODGE CORPORATION, BISBEE, ARIZONA

By J. B. PULLEN *

THE Copper Queen Mines, as can be judged from their names, are, in the main, producers of copper. They are situated in the Warren Mining District of Arizona, where operations have been in progress almost continuously for the past 50 years.

The total Copper Queen holdings in this district amount to 4,811 acres. The productive area in which mining operations have been confined comprises, roughly, around 550 acres, with a vertical extent of about 2,600 feet. It has been estimated that during this long period of operation, approximately 300 miles of underground drifts and cross cuts have been driven and over 18,000,000 tons of ore extracted by underground methods.

The ore bodies being mined are of two general types: The replacement ore bodies in limestone sometimes associated with porphyry and the disseminated sulphide secondarily enriched ores in the main granite porphyry stock. The zone in which the replacement ore bodies occur has a known extent of 400 ft. vertically, extending in a northwest and southeast direction for 10,000 ft. and is 4,000 ft. wide. The dip is to the east, making the western limit of this zone about 2,700 ft. higher than the eastern limit. It must not be inferred that this zone is all ore, as the ore bodies are small and most of them tabular in shape, having a horizontal area of about 150 ft. by 75 ft., and are about 50 ft. thick. These are scattered all through this zone, in no degree of uniformity.

During the many years of operation almost every known method of mining has been employed. At present the low-grade porphyry ores are extracted by the open-cut, steam-shovel method and by underground caving. In the limestone mines three methods are almost in standard practice—top slicing, square setting and the inclined cut and fill.

Extensive Workings And Two Active Mine Fires Requires Efficient And Careful Ventilation—General Plan Of Ventilation Described With Methods And Devices For Air Control—Capacity And Tests On Fans

The following table will give the proportionate amounts of the total underground production extracted by the various methods:

Caving	44%
Top slice	32%
Square set	22%
Cut and fill	2%
Total	100%

The underground mines are now being operated in four units: One porphyry caving division in which the operations extend from the 600 level to the 1,000 level and three limestone divisions. Of these three limestone divisions, one extends from the surface to the 400 level and up into the mountains south of the city of Bisbee for a vertical distance of 400 ft., making the operations extend over seven different mine levels. The upper levels are all connected with the surface by tunnels or adits, and are connected with the lower levels by a series of shafts and raises. Ventilation in this area is a very simple problem and practically takes care of itself. Only an occasional study is made of the conditions here, and always with the idea of fire protection in mind. The other two limestone divisions extend from the 900 level to the 1,800 level, and with the porphyry division are all operated through the same shafts and are mechanically ventilated. Figure 1 shows a plan of the productive area in which mining operations are being carried on.

The most difficult problem in the underground ventilation of the Copper Queen is the scattered nature of the operations. Production is obtained on the average from 50 stopes. The underground transportation of the ore requires over 30,000 ft. of trackage.

The underground haulage system is fed from over 80 chutes. The nature and occurrence of the ore bodies make it imperative to carry on an extensive development campaign at all times. During the past six years development work has been in almost constant progress in about 75 different faces, of which 25 have been in the most remote sections of the mines. Aside from all this, there are two active mine fires in the ventilated area of the Copper Queen Mines, and one in the adjoining workings of a neighboring mine. The fires are isolated from the rest of the workings by a series of bulkheads and brattices; nevertheless a constant pressure must be maintained against all the stoppings to make certain that all the gases and smoke will be confined behind them. Furthermore, a great many of the ore bodies being mined are sulphides associated with porphyry, and the rock temperature in some cases is as high as 80° F.

A study of these conditions will disclose that the mines are warm and humid, that it is necessary to have exceedingly long and irregular passages for the

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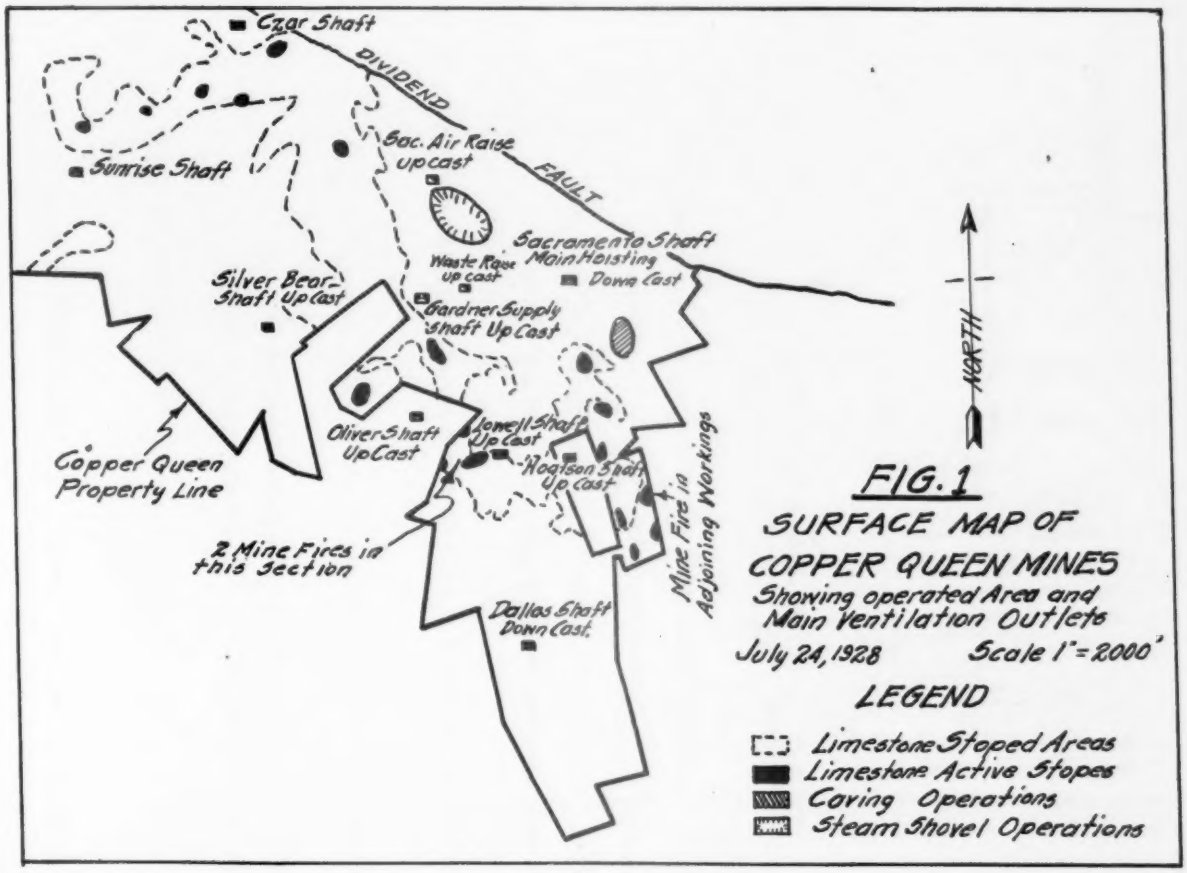


air, that an abnormal amount of exhausts are required, also that the workings are so interconnected it is necessary to guard against short-circuited currents constantly, and that an abundant supply of fresh air is required at all times.

General Plan of the Underground Ventilation System

Fresh air is brought into the mines through two down-cast shafts, the Sacramento and the Dallas. The Sacramento, which is the main operating and ore hoisting shaft, is a five compartment concreted shaft having a cross sectional area of 114 sq. ft. The collar is at an elevation of 5,266 ft. above sea level, and the bottom, or 1,800 level, is at an elevation of 3,536. The Dallas Shaft at present is being held as an auxiliary operating shaft, to be used in case of an emergency. It is a four compartment concreted shaft extending to the 1,800 level. The collar is at an elevation of 5,429 ft. above sea level. The cross-sectional area of this shaft is 160 sq. ft. The temperature of the air at the collar of these shafts in August, 1928, was 82° F. and the relative humidity figured around 24 percent.

The mechanical ventilation is maintained by four electrically driven blowers situated on the 1,000, 1,500 and 1,600 Sacramento levels and the 1,400 Dallas level. Table I gives the general description of these fans:

There are seven principal exhausts to surface: Gardner Shaft, Lowell Air Shaft, Silver Bear Shaft, Sacramento Air Raise, Gardner Waste Raise, Oliver Shaft, Hoatson Shaft.

The average temperature of exhausted air is about 76° F., with the relative humidity being 97%.

The Oliver and Hoatson Shafts are owned by the Calumet and Arizona Mining Company, and air exhausted through these outlets is routed through adjoining workings. Figure 1 will show the location of all these exhausts.

Air delivered by the 1,000 blower is pulled down through the Sacramento Shaft and provides primary ventilation for the porphyry Caving Division. This air enters the bottom workings on the 1,000 level. From there it is routed and distributed to the upper workings and exhausted to the Gardner Shaft on the 800 and 600 levels.

The 1,400 Dallas blower delivery is pulled down through the Dallas Shaft. This air is used to ventilate the Lowell and Gardner countries, in which the workings extend from the 1,400 to 900 levels. In the Lowell country there are two active mine fires sealed off from the rest of the workings, and, as precautionary measure against having the rest of the mine contaminated with gases, a concreted raise has been constructed between the 1,100 and 1,000 levels, giving the air from around this vicinity a separate route to one of the main exhausts, which is the Lowell Air Shaft. The air which ventilates the Gardner workings is routed up raises to the 1,300 level; from there it is coursed almost continuously through stoping sections to the main exhaust air routes. This air is exhausted to the Gardner Shaft on the 1,200, 1,100 and 900 levels, to the Gardner Waste Raise on the 900 level and to the Silver Bear Shaft on the 800 level.

The air from the 1,500 blower is pulled down through the Sacramento Shaft and is used mainly to ventilate the workings between the 1,500 and 1,300 level of the Sacramento Division; from this section about 35 percent of the total limestone mine production is obtained. The air is routed up to the 1,400 level through stoping sections and raises. The ground above the 1,400 level is very wet and extremely heavy, and it has been impossible to hold open air routes out of the stoping sections above the 1,400 level. This has made it necessary to go into

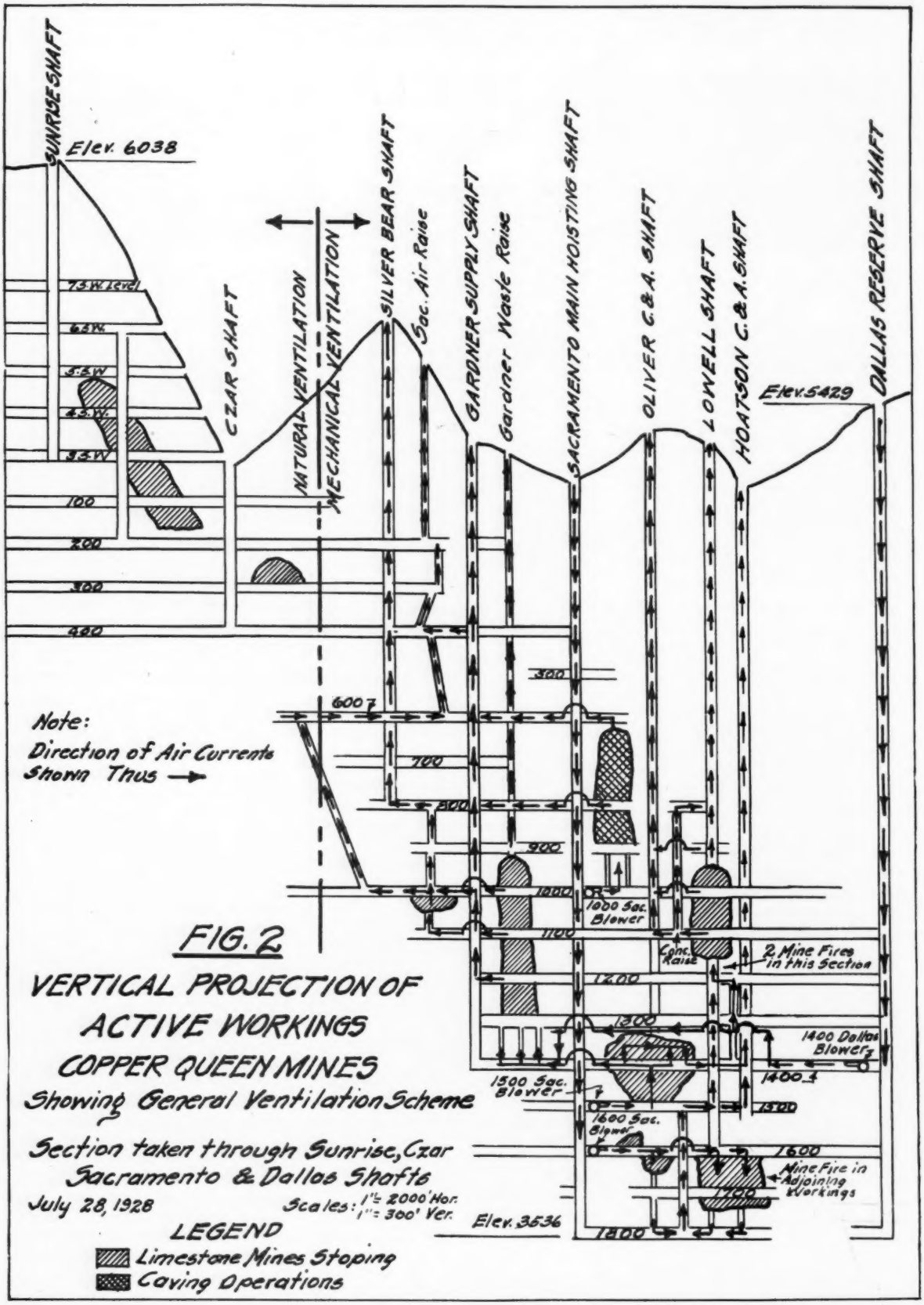


FIG. 2

VERTICAL PROJECTION OF ACTIVE WORKINGS COPPER QUEEN MINES

Showing General Ventilation Scheme

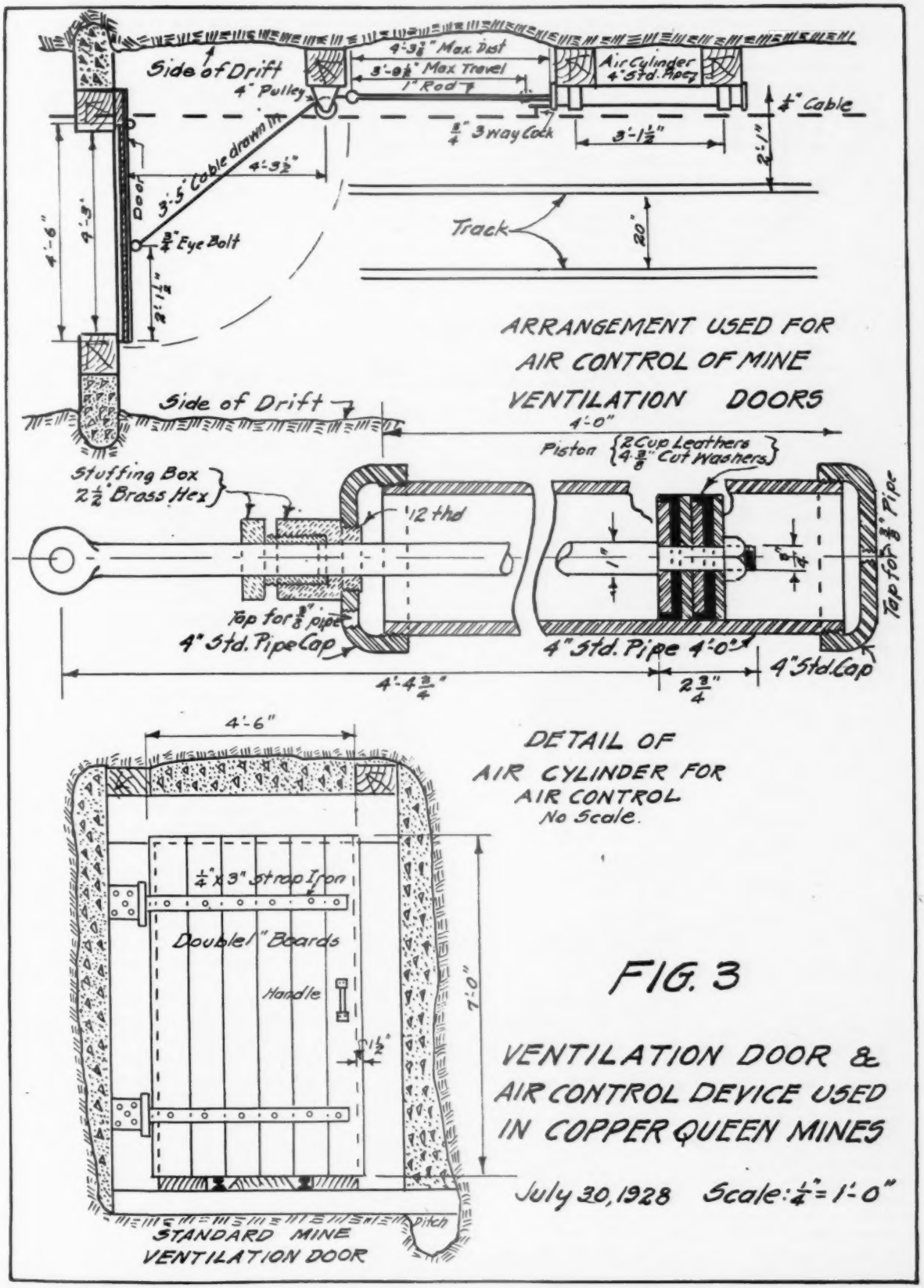
Section taken through Sunrise, Czar Sacramento & Dallas Shafts

July 28, 1928 Scales: 1" = 2000' Hor. 1" = 300' Ver.

LEGEND

Limestone Mines Stoping

Caving Operations


Side of Drift
4" Pulley
4'-3⅜" Max. Dist
3'-0½" Max Travel
1" Rod
Air Cylinder 4" Std. Apex
¼" Cable
¼" 3 way Cock
3'-1½"
2'-1"
3'-5" Cable drawn in
4'-3½"
Door
4'-6"
4'-3"
⅜" Eye Bolt
2'-1"
Track
20"
ARRANGEMENT USED FOR AIR CONTROL OF MINE VENTILATION DOORS
Side of Drift
4'-0"
Piston {2 Cup Leathers, 4 ⅜" Cut Washers}
Stuffing Box 2½" Brass Hex
12 thd
Top for ⅜" pipe
4" Std. Pipe Cap
4" Std. Pipe 4'-0"
Top for ⅜" Pipe
4'-4¾"
2¾"
4" Std. Cap
4'-6"
¼" x 3" Strap Iron
Double 1" Boards
Handle
1½"
7'-0"
Pitch
STANDARD MINE VENTILATION DOOR
DETAIL OF AIR CYLINDER FOR AIR CONTROL
No Scale.
FIG. 3
VENTILATION DOOR & AIR CONTROL DEVICE USED IN COPPER QUEEN MINES
July 30, 1928 Scale: ¼" = 1'-0"

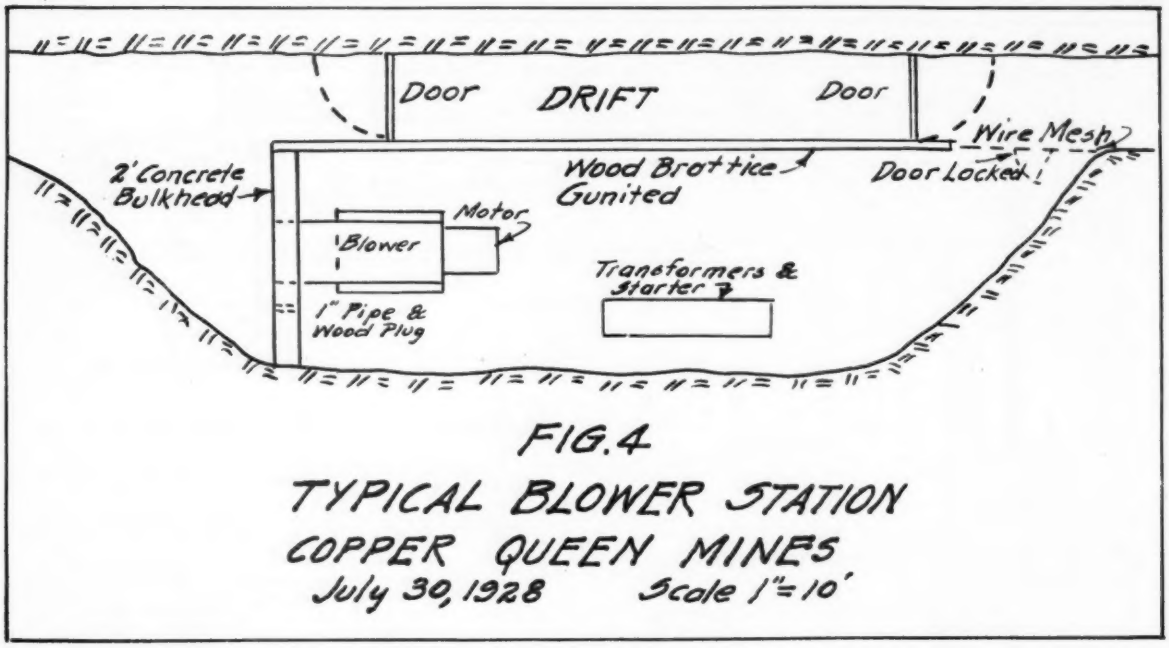


FIG. 4

TYPICAL BLOWER STATION

COPPER QUEEN MINES

July 30, 1928 Scale 1"=10'

auxiliary ventilation in this area. The air is forced up into stopes by small blowers through canvas tubing or metal piping, and allowed to percolate back down to the 1,400 level through the various stope manways. The main exhaust for this air is the Hoatson Shaft. Although part of it is mixed with Dallas air on the 1,400 level and exhausted with the rest of the Gardner-Lowell air.

Air from the 1,600 blower is pulled down through the Sacramento Shaft and is used mainly to ventilate the workings between the 1,600 and 1,800 levels. Between the 1,600 and 1,700 levels the workings connect with the workings of a neighboring mine in which there is an active mine fire sealed off. This requires adequate pressure to prevent the gases behind these seals from entering the mine workings. The bulk of the air from this blower is routed through stoping sections and raises to the 1,800 level, back up a three-compartment winze to the 1,500 level. From there, part of it is exhausted to the Hoatson Shaft, the balance is routed up the Lowell Shaft to the 1,200 level, and then up through stoping sections and raises to the 1,100 level, from where a part of it is exhausted to the Oliver Shaft. The rest is mixed with the Lowell air and exhausted out the Lowell Air Shaft.

TABLE I

THEORETICAL CAPACITIES OF PRIMARY BLOWERS

Blower	Make	Design	Size	Volume	Pressure	Hp. Required	R. p. m
1,000 Sacto	Sirocco		7	35,000	2½"	35	451
1,400 Dallas	Sturtevant Multivane	3	11	106,000	3"	100	360
1,500 Sacramento	Sturtevant Multivane	2	11	95,800	2½"	75	329
1,600 Sacramento	Sturtevant Multivane	3	12	131,000	3"	125	324

ACTUAL OPERATING DATA

Blower	Make	Design	Size	Motor	Volume Delivered	Static Pressure	Hp. Consumed
1,000 Sacto	Sirocco		7	40 Hp.	32,000	1⅝"	26.8
1,400 Dallas	Sturtevant Multivane	3	11	150 Hp.	72,500	2-3/16"	57.9
1,500 Sacto	Sturtevant Multivane	2	11	50 Hp.	77,000	2"	45.0
1,600 Sacto	Sturtevant Multivane	3	12	150 Hp.	112,000	2⅛"	72.2

(Operating data taken from test made January, 1928)

Table II

TESTS ON UNDERGROUND PRIMARY BLOWERS—YEAR 1927
(Power data by electrical department; other data by engineering department)

		Intake					Delivery						
Blowers	Date	Volume cu. ft. per min.	Temperature W.B.	Temperature D.B.	Rel. hum.	Hp. consumed	Volume cu. ft.	Temperature W.B.	Temperature D.B	Rel. hum.	Static pressure	Hp. delivered	Mech. eff. %
1000 Sacto	Jan. 21, 1927	31280	56°	61°	74%	24.12	27430	57°	63°	74%	2"	8.48	35.16
	July 21, 1927	38383	72°	76½°	80%	20.72	38746	72½°	77½°	79%	1¼"	7.63	36.82
1400 Dallas	Jan. 21, 1927	52839	62°	66°	81%	45.02	59922	63°	68°	77%	2 3/16"	20.68	45.93
	July 21, 1927	48764	66°	70°	82%	51.50	63251	68°	73°	77%	2⅜"	28.79	55.90
1500 Sacto	Jan. 21, 1927	68282	59°	65°	71%	33.24	70500	60°	67°	68%	1⅝"	18.05	54.31
	July 21, 1927	71876	76°	80°	84%	39.48	74500	76°	80°	84%	2 3/16"	25.68	65.05
1600 Sacto	Jan. 21, 1927	90645	60°	60°	72%	60.20	88038	62°	68°	72%	2 3/16"	30.38	50.47
	July 21, 1927	76540	78°	82°	84%	61.00	85000	80½°	84½°	84%	2¼"	49.30	49.30

Table III

Required volume	Estimated pressure	Use this blower equipment with this motor	
1500 to 2000	Up to 5"	No. 4 Monogram	3 to 5 hp.
1800 to 2500	5" to 7"	No. 5 Monogram	5 hp.
2500 to 3500	7" to 11"	No. 6 Monogram	10 hp.
3000 to 8000	2" to 4"	No. 4 Des. 3 Multivane	10 hp.

The Gardner Shaft, which is used only for supplies, is a three-compartment timbered shaft having a cross-sectional area of 63 sq. ft., 45 of which are effective for air passage. The shaft is a much overworked exhaust, and on the 400 and 1,000 levels air is allowed to leak out of the shaft and is routed through old workings to the Sacramento Air Raise, which exhausts it to the surface.

Figure 2 is a vertical section of the workings, and will show the general scheme of ventilation.

Approximately 100 doors are required underground to control the currents and route the air. The doors are made with double 1-in. boards with roofing paper in between; on one side the boards are laid lengthwise and on the other side crosswise to prevent warping. The doors are hung to wooden frames set in concrete by strap iron hinges. The doors always open against the current, and close against the frame rather than set in it, making them easy to operate, regardless of whether they swell or warp. The doors are weighted so that a change (reversal) of the air current will not open them.

On haulage levels and in tramming drifts the doors are equipped with an air-control device whereby they can be opened or closed at some distance from the door. Figure 3 shows a plan of these doors and arrangements necessary for air control.

The blower stations are all similar in design. The blower, motor, transformer, and switchboard stand are all set on concrete foundations. The station is sealed off from the adjoining drift with a wooden brattice which is gunited. Two air-operated doors are placed between the air inlet and outlet of the station to prevent the air from being short circuited. Figure 4 will show a typical plan of one of these stations.

The primary blowers are tested twice each year. Table II gives a compilation of the results obtained from these tests.

The readings taken for the tests are always taken simultaneously. The power readings are taken with a portable watt meter, the air velocities are measured with an anemometer, pressure readings are taken with a "U" tube graduated to 1/16-in., temperature readings are taken with a sling psychrometer. The drift sections where the air readings are taken are well marked and have been accurately located and measured; the areas have also been calculated very closely. The readings of each test for each blower are always taken in the same sections. While there is always a certain degree of inaccuracy in any test, it is assumed that by taking the readings always in the same section, the error will be fairly constant and the results will be comparable. In making these tests it has been found that if a number of anemometer readings are taken at various places in the section and averaged, the results will be more nearly accurate than if the entire section is traversed by the instrument in a single reading, which has been quite common practice in this vicinity.

Once a year a complete ventilation survey is made of the entire mine. This survey consists of mapping and measuring all air currents, locating and inspecting all the ventilation doors and taking psychrometer reading in all sections of the mine; all bulkheads and brattices are located and inspected, all openings which have caved or closed are noted, and special attention is given to determine amounts of air being short circuited. At the completion of the survey, ventilation maps are made, other data tabulated, and a report made to the mine superintendent, with recommendations for remedying bad conditions found. A conference of all who are vitally interested is then held, the whole situation is thrashed out and steps are immediately taken to better conditions.

Testing the fans and making a ventilation survey at regular intervals are of utmost importance, as the fan test will show whether or not the equipment is giving the desired performance and will usually show up such defects as dirty fans, motors in need of repair, or defective doors. The ventilation survey will show whether or not full benefit is being derived from the air delivered by the blower. Also accurate information will be obtained regarding the condition of doors and stoppings, and short-circuited air will be detected.

The scattered operations and extensive workings make the ventilation problems in this mine very complex. Yet by careful routing of air, keeping the main air passages free from obstructions, the mine resistance has been held below a pressure of 3-in. for the volumes delivered. No radical change has been made in the ventilation system since its original installation in 1918. However, the mine has finally outgrown the system in some respects, and a few changes will be necessary in the near future. The first one contemplated is to move the 1,600 blower to the 1,800 level; this will lessen the distance the air from this blower has to travel, which will lower the resistance and allow a greater amount of air to be circulated.

There has been no particular standard adopted as to the amount of fresh air to be supplied per man per minute; however, when conditions were the very worst, the amount was around 225 cu. ft. per man per minute, and in most cases the amount is over 325 cu. ft. per man per minute.

Where it is necessary to go into secondary ventilation, either coppus air turbines or small electrically driven blowers and canvas tubing are used.

Table III is used for making a selection of equipment to use in this sort of ventilation:

Twelve-in. canvas tubing is in standard use, except where the distance to pipe the air is comparatively short; then smaller sections are used, and when exceedingly large volumes are required larger sections are used.

In conclusion it might be well to repeat a few of the main principles which govern ventilation.

Air in its flow is similar to water, and when routed through straight regular passages it will flow along at a fairly even rate, requiring only a small pressure behind it for a large quantity of delivery, but when met with obstructions, eddies and ripples occur which retard the flow and require more pressure to maintain the same quantity of delivery.

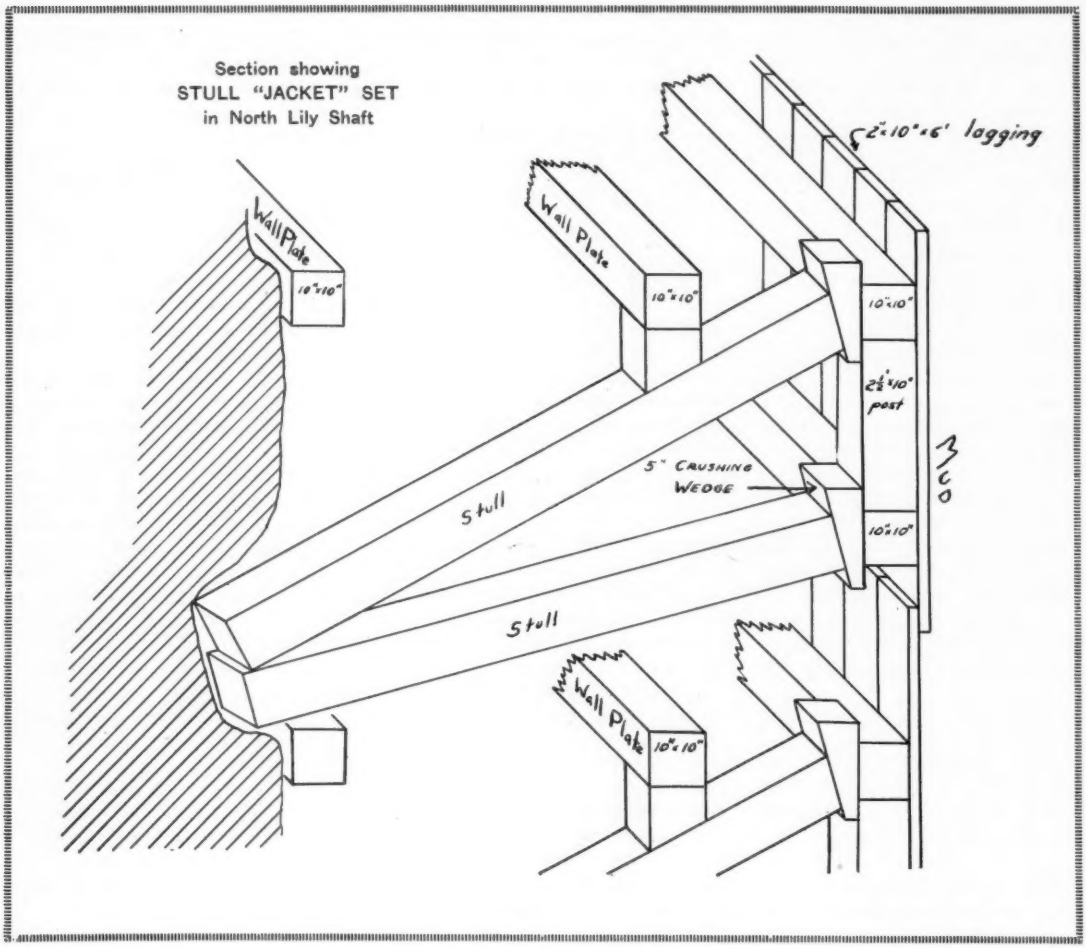
The volume of air delivered varies directly as the speed, the pressure or mine resistance varies as the square of the volumes, and the required power varies as the cube of the volumes. In working out a ventilation system an attempt should be made to keep all these factors within economic limits.

The purpose of mine ventilation is to bring about healthful, comfortable and pleasant working conditions for the man underground. This in turn should increase his efficiency in the performance of his duties.

It is impossible to show in dollars and cents just what benefits the company has derived from the installation of mechanical ventilation. Nevertheless it is a recognized fact that certain sections of the mine could not be worked without it. Also, by bringing about such improved conditions it is natural to assume that the efficiency of the underground men must have increased to some extent. Aside from this, good working conditions will attract good men, making it easier to build up a productive organization. This alone is certain to have a favorable effect on costs.

MINING ENGINEER EXAMINATIONS

The United States Civil Service Commission has announced competitive examinations for mining engineers at $3,800 per year and two associate mining engineers at $3,200 per year and $2,600 per year, and will receive applications up to October 3. The examination is to fill vacancies in the Bureau of Mines for duty in Washington or in the fields in connection with investigations for studies connected with mining. Full information may be obtained from the United States Civil Service Commission, Washington, D. C.



The NORTH LILY SHAFT *at* EUREKA, UTAH

By J. S. FINLAY*

Four Compartment Shaft Sunk Under Extremely Unfavorable Conditions, Encountered Almost At The Grass Roots—A Brief Description Of How The Difficulties Were Overcome

THIS four-compartment shaft, sunk from surface in ryolite, ran into trouble almost at the grass roots. Large slabs slid in along wet slips causing trouble and delay for 50 ft., when enough solid ground was found to put in bearing-sets. Ten ft. below the bearings-sets the shaft botton fell into an open cave—the bottom being mud and boulders. Sinking through this, the hanging-rods pulled apart and the timbers settled.

For a considerable distance the west side of the shaft was fairly solid and angle-braced jacket sets were put in 4 ft. back of the wall-plates on east side. This also settled and a system of stulls across the shaft was tried. The shaft-posts were removed and stulls put across the shaft from hitches on west side to horizontal stringers, with vertical lagging behind them, 3 ft. back of wall plate on east side. Between shaft-sets eight stulls were placed—four sets of double stulls. On the west side the stulls were in the same hitch, one above the other. On the east side the lower stull and stringer was 1½ to 2 ft. higher than on the west side, and east end of upper stull still 2½ ft. higher, so that settling of stringers and lagging would tighten the stulls. A 5 by 10-in. crushing block was placed between each stull and stringer to give warning in case sufficient weight developed to break the stulls.

This seheme worked so well that an inspection several months after placing the stulls showed them to have settled 6 in. on the high end, the blocks to be crushed a maximum of ¾ in. and that the shaft timbers had not moved. Blocking was placed above the stulls but none below, allowing the stulls to settle without pushing the shaft timbers with them.

At a depth of 450 ft. the west wall of shaft dipped west and spoiled the hitch and stull scheme. For 100 ft. we put in stringers and lagging behind the wall plates on both (*Continued on page* 708)

* Superintendent, North Lily Mining Company, Eureka, Utah.

REVISION *of the* COARSE CRUSHING *and* FINE CRUSHING DEPARTMENTS *of the* HURLEY PLANT *of the* CHINO MINES, NEVADA CONSOLIDATED COPPER COMPANY

By FRED HODGES *

Fine And Coarse Crushing—Screen Analyses — Comparative Performance Of Rod And Roll Mills On Medium Hard Ore — Power Consumption — Costs And Capacities — Flow Sheets For Fine And Coarse Crushing

PRIOR to March, 1927, the Coarse Crushing Department at the Hurley Plant contained two units, each unit consisted of a feeder conveyor from the coarse-ore bins, which discharged onto a 2½-in. grizzly ahead of the No. 8 McCully gyratory crusher, the grizzly oversize went to the crusher and the undersize to the Chino impact screen. The undersize of this screen was a finished product and the oversize joined the crusher product in a 38-in. elevator, which was in closed circuit with one 72-in. by 20-in. Garfield roll, two Chino impact screens, and a short circulating conveyor. (See Figure No. 1.)

Under normal operating conditions when the mine delivered ore of medium

* Superintendent of Mills, Chino Mines, Nevada, Consolidated Copper Co.

TABLE I

	Symons crusher unit	Gyratory crusher unit
Crusher set to	½"	2½"
Screens ahead of crusher	¾" x 1½"	
Impact screens		¾" x 1½"
Hum-mer screens	⅜" x ¾"	
Tons of feed per hour	286	322

Power Consumption; Average Motor Imput K. W.

Symons crusher	87.20	Gyratory crusher	39.50
Rolls	98.40	Rolls, screens and elevators	144.00
Elevator	54.90	Return belt	5.30
Hum-mer screens	.90		
Drum feeders	1.00		
Return belt	4.35		
Total	246.75	Total	188.80
K. W. H. per ton of ore through .371" mesh	0.87	K. W. H. per ton of ore through .371" mesh	1.10

Screen Analysis

	Symons product Percent weight Ind.	Symons product Percent weight Accum.	Gyratory product Percent weight Ind.	Gyratory product Percent weight Accum.
On 1.050 Inch	.8	.8	71.5	71.5
.742	5.4	6.2	12.5	84.0
.525	15.9	22.1	5.2	89.2
.371	22.1	44.2	3.1	92.3
.263	14.1	58.3	1.9	94.2
.185	9.5	67.8	1.4	95.6
On 10 Mesh	14.1	81.9	2.0	97.6
14	2.1	84.0	.3	97.9
20	1.8	85.8	.2	98.1
28	1.7	87.5	.1	98.2
35	1.7	89.2	.2	98.4
48	1.6	90.8	.2	98.6
65	1.2	92.0	.2	98.8
100	1.2	93.2	.1	98.9
150	.9	94.1	.1	99.0
200	.9	95.0	.1	99.1
Through 200	5.0	5.0	.9	.9

	Finished product Symons Percent weight Ind.	Finished product Symons Percent weight Accum.	Finished product Gyratory Percent weight Ind.	Finished product Gyratory Percent weight Accum.
On 1.050 Inch	...	...	...	...
.742	...	...	6.4	6.4
.525	...	...	23.8	30.2
.371	.8	.8	16.8	47.0
.263	8.0	8.8	11.0	58.0
.185	15.2	24.0	7.0	65.0
On 10 Mesh	29.0	53.0	12.4	77.4
14	6.0	59.0	3.0	80.4
20	4.4	63.4	2.4	82.8
28	5.0	68.4	2.0	84.8
35	4.2	72.6	2.0	86.8
48	3.6	76.2	1.6	88.4
65	3.4	79.6	1.2	89.6
100	3.6	83.2	2.2	91.8
150	2.6	85.8	1.2	93.0
200	3.0	88.8	2.0	95.0
Through 200	11.2	11.2	5.0	5.0

TABLE II

	Symons crusher unit	Gyratory crusher unit
Crusher set to	½"	2½"
Screens ahead of crusher	¾" x 1½"	
Impact screens		¾" x 1½"
Hum-mer screens	¼" x ¾"	
Tons of feed per hour	235	269

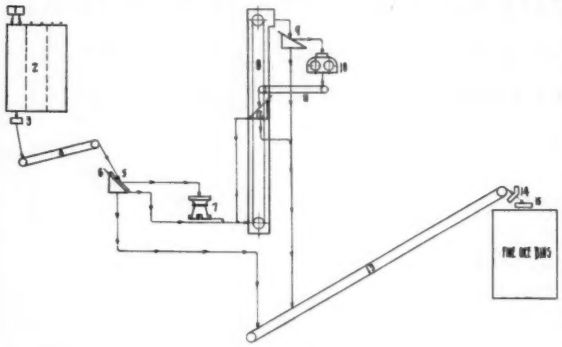
Power Consumption; Average Motor Imput K. W.

Symons crusher	76.00	Gyratory crusher	36.00
Rolls	150.00	Rolls, screens and elevators	150.00
Elevator	60.00	Return belt	5.00
Hum-mer screens	.90		
Drum feeders	1.00		
Return belt	4.00		
Total	291.90	Total	191.00
K. W. H. per ton of ore through .263 mesh	1.25	K. W. H. per ton of ore through .263 mesh	2.35

Screen Analyses

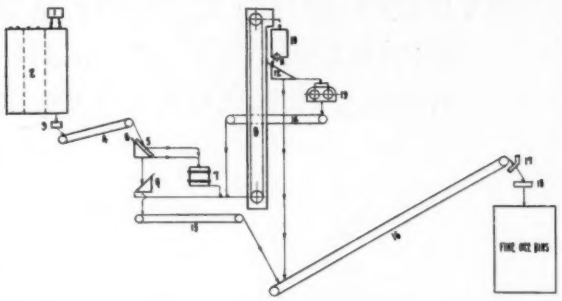
	Symons product Percent weight Ind.	Symons product Percent weight Accum.	Gyratory product Percent weight Ind.	Gyratory product Percent weight Accum.
On 1.050 Inch	8.5	8.5	84.8	84.8
.742	22.0	30.5	6.4	91.2
.525	26.1	56.6	3.3	94.5
.371	16.1	72.7	1.6	96.1
.263	9.7	82.4	1.1	97.2
.185	6.6	89.0	0.8	98.0
On 10 Mesh	6.1	95.1	0.8	98.8
14	0.6	95.7	0.1	98.9
20	0.5	96.2	0.1	99.0
28	0.5	96.7	0.1	99.1
35	0.4	97.1	0.1	99.2
Through 35	...	...	0.8	0.8
48	0.3	97.4	...	...
65	0.3	97.7	...	...
100	0.3	98.0	...	...
150	0.2	98.2	...	...
200	0.3	98.5	...	...
Through 200	1.5	01.5	...	...

	Finished product Symons Percent weight Ind.	Finished product Symons Percent weight Accum.	Finished product Gyratory Percent weight Ind.	Finished product Gyratory Percent weight Accum.
On 1.050 Inch	...	...	...	...
.742	...	...	10.0	10.0
.525	...	...	24.8	34.8
.371	0.4	0.4	22.2	57.0
.263	1.6	2.0	12.8	69.8
.185	15.8	17.8	8.1	77.9
On 10 Mesh	40.0	57.8	7.0	84.9
14	6.4	64.2	2.2	87.1
20	4.7	68.9	1.7	88.8
28	4.5	73.4	1.5	90.3
35	4.4	77.8	1.2	91.5
48	2.7	80.5	1.0	92.5
65	2.8	83.3	1.0	93.5
100	3.1	86.4	1.3	94.8
150	2.3	88.7	0.7	95.5
200	2.5	91.2	1.0	96.5
Through 200	8.8	08.8	3.5	03.5



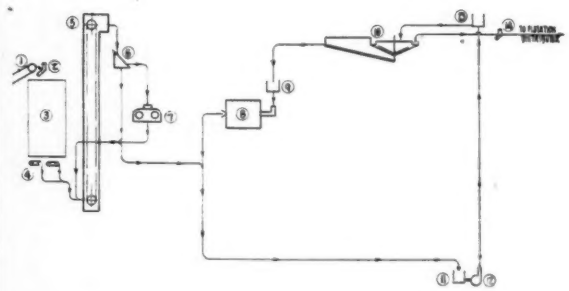
Mk.	No.	DESCRIPTION
1		50-ton ore cars.
2		Ore bins, 22,950-ton cap., 30′ H. x 45′ W. x 300′ L.
3	40	Steel apron feeders, 33″ W. x 20 f. p. m., 4 operating 6.2 k. w. h.
4	1	Belt conv., 34″ x 675′ x 320 f. p. m., 30 hp. motor, 29 k. w. h.
5	1	Grizzly, 4′ x 10′ x 2½″ opening.
6	1	Chino screen, 4′ 6″ x 6′ 6″ x ¾″ x 1½″ opening.
7	1	No. 8 McCully crusher, 2½″ opening, 50 hp. motor, 39.5 k. w. h.
8	1	Elevator, 38″—18½″ x 8″ x 10″ buckets Sp. 9″ 480 f. p. m.
9	1	Chino screen, 4′ 9″ x 6′ 6″ x ¾″ x 1½″ opening. — 200 hp. motor, 144 k. w. h.
10	1	72″ x 20″ Garfield roll.
11	1	Picking conveyor.
12	1	Chino screen, 4′ 6″ x 6′ 6″ x ¾″ x 1½″ opening. — 15 hp. motor, 5.3 k. w. h.
13	1	Incline conveyor, 275′ x 36″ x 450 f. p. m., 100 hp. motor, 44 k. w. h.
14	1	Head sampler.
15	1	Shuttle conveyor, 30 hp. motor, 12.2 k. w. h.

FIGURE 1
UNIT No. 3 FLOW SHEET
COARSE CRUSHING PLANT



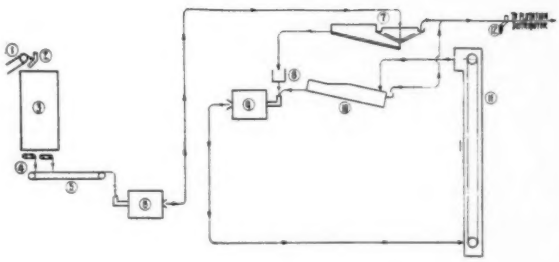
Mk.	No.	DESCRIPTION
1		50-ton ore cars.
2		Ore bins, 22,950 ton cap., 30′ H. x 45′ W. x 300′ L.
3	19	Steel-apron feeders, 33″ W. x 20 f. p. m., 4 operating 8.3 k. w. h.
4	1	Belt. conv., 34″ x 600′ x 240 f. p. m., 30 hp. motor, 26 k. w. h.
5	1	Grizzly, 3′ 10″ x 9′ 0″, 2½″ opening.
6	1	Primary screen, 4′ 6″ x 6′ 6″ x ¾″ x 1½″ opening.
7	1	7′ Symons crusher, 200 hp. motor, 87.2 k. w. h.
8	1	38″ elevator, 18½″ x 8″ x 10″ buckets, Sp. 9″, 515 f. p. m., 100 hp. motor, 54.9 k. w. h.
9	1	Hum-mer screen, ⅜″ x ¾″ opening, .18 k. w. h.
10	1	Surge bin.
11	4	Roll type feeders, 22″ ϕ x 3′ 10½″, 2 hp. motor, 1 k. w. h.
12	4	Hum-mer screens, ⅜″ x ¾″ opening, each .18 k. w. h.
13	1	72 x 20 Garfield roll, 200 hp. motor, 98.4 k. w. h.
14	1	Conv. belt, 42″ x 60′, 7½ hp. motor, 4.35 k. w. h.
15	1	Conv. belt, 20″ x 50′.
16	1	Incline conveyor, 275′ x 36″ x 450 f. p. m., 100 hp. motor, 43 k. w. h.
17	1	Head sampler.
18	1	Shuttle conveyor, 25 hp. motor, 13.6 k. w. h.

FIGURE 2
UNIT No. 1 FLOW SHEET
COARSE CRUSHING DEPARTMENT



Mk.	No.	DESCRIPTION
1	2	36″ incline conveyors.
2	2	Automatic electric samplers, cutting every eight minutes.
3	2	Fine ore bins.
4	4	Steel Apron feeders.
5	1	38″ bucket elevator.
6	8	Chino impact screens.
7	2	42″ x 16″ Garfield rolls.
8	3	7′ x 10′ Chino ball mills, 19.9 r. p. m.
9	1	Three-way distributor.
10	2	Dorr model D. S. D. B. 8′ x 26′ 8″ x 15′ bowl classifiers.
11	1	8″ Wilfley pump sump.
12	2	8″ Wilfley pumps—one operating.
13	1	Two-way distributor.
14		Automatic electric samplers—cutting every eight minutes.

FIGURE 3
FLOW SHEET
FINE CRUSHING WITH ROLLS



Mk.	No.	DESCRIPTION
1	2	36″ incline conveyors.
2	2	Automatic electric samplers—cutting every eight minutes.
3	2	Fine ore bins.
4	4	Steel apron feeders.
5	2	Belt conv., 30″ x 26′ 0″ ctrs.
6	1	8′ x 12′ Chino rod mill, 13.4 r. p. m.
7	2	Dorr model D. S. D. B. 8′ x 26′ 8″ x 15′ bowl classifiers.
8	1	Two-way distributor.
9	3	7′ x 10′ Chino ball mills, 16.5 r. p. m.
10	3	8′ x 26′ 8″ drag classifiers.
11	2	20″ bucket elevators.
12		Automatic electric samplers—cutting every eight minutes.

FIGURE 4
FLOW SHEET
FINE CRUSHING WITH ROD MILL

TABLE III

Screen Analyses—Crusher Product

	Percent weight Ind.	Accum.
On 1.050 Inch	7.5	7.5
.742	20.0	27.5
.525	19.9	47.4
.371	11.3	58.7
.263	8.0	66.7
.185	5.6	72.3
On 10 Mesh	10.6	82.9
14	2.2	85.1
20	1.6	86.7
28	2.1	88.8
35	2.5	91.3
48	0.9	92.2
65	0.9	93.1
100	1.2	94.3
150	0.4	94.7
200	0.6	95.3
—200	4.7	4.7

TABLE IV

	Rolls	Rod Mill
Tons Per Day	1,730	2,405
Screen Analyses	**Feed** / **Product**	**Feed** / **Product**
On .742 inch	3.4	3.0 ....
.525	24.4	19.0 ....
.371	42.8	39.4 ....
4 Mesh	62.6	60.4 ....
6	68.4	66.4 ....
10	75.0 2.4	72.6 1.2
14	77.2 9.6	76.0 4.0
20	79.4 17.6	78.4 9.2
28	81.8 25.2	80.2 18.0
35	84.4 34.4	83.0 29.0
48	86.4 41.4	84.8 38.8
65	88.2 47.2	87.4 47.2
100	90.4 56.0	90.4 57.0
150	92.4 60.0	91.8 64.6
200	93.8 69.2	93.6 71.2
—200	6.2 30.8	6.4 28.8
Tons Reduced:		
Through 65 Mesh	709	967
Through 100 Mesh	595	803

Consumption Per Ton

	Milled	Reduced Through 65 Mesh	Reduced Through 100 Mesh
Power K. W. H.:			
Rolls, Elevators and Screens	2.08	5.08	6.04
Rod Mill and Pump	1.91	4.75	5.72
Steel-Pounds:			
Rolls	.1119	.2730	.3253
Rod Mill	*.4654	1.1575	1.3938

*Includes 3-in. rods at .4313 lbs. and white iron side liners, end liners, throat liners and lifting bars at .0341 lbs.

Cost Per Ton

	Milled	Reduced Through 65 Mesh	Reduced Through 100 Mesh
Rolls:			
Power	0.0208	.0508	.0604
Steel	0.0093	.0227	.0270
Maintenance	0.0141	.0344	.0410
Total	0.0442	.1079	.1284
Rod Mill:			
Power	0.0191	.0475	.0572
Steel	0.0134	.0333	.0401
Maintenance	0.0049	.0122	.0146
Total	0.0374	.0930	.1119

hardness containing the average percentage of fines each unit finished to minus ¾-in. mesh. During hard-ore delivery, when the percentage of fines were minimum, the two gyratory crushers were not of sufficient capacity to handle the desired tonnage; therefore plant enlargement was necessary. A spare 72-in. by 20-in. roll was already at hand, so it became a question of duplicating the existing crushers, or installing a crusher that would not only give the desired capacity but would also permit of a much finer product from this department.

After considerable investigation and certain guarantees from the builders a 7-ft. heavy duty Symons cone crusher was selected, and, as shown by the flow sheet, figure 2, was placed in operation ahead of a 38-in. elevator, which is in closed circuit with four Type 39, 4 ft. by 5-ft. Hum-mer screens, one 72-in. by 20-in. Garfield roll and a short 42-in. return conveyor. It will be noted that instead of following common practice of constructing a system of incline conveyors to transport the crusher product and the circulating load to the screening tower a 38-in. elevator is used and discharges directly into a surge bin, from which the ore is fed by drum-type feeders onto the Hum-mer screens located immediately above the roll. This construction was chosen, as it was readily adaptable to the conversion of the existing plant and saved approximately $100,000 for the complete remodeling of all units over a plant equipped with a system of conveyors. The unit is performing in an entirely satisfactory manner and under normal operation is producing minus ¼-in. material at the rate of 286 tons per hour, the roll being the limiting factor.

The tabulation of tests shows the performance of the Symons crusher unit and its comparison to the gyratory unit.

Test March 28, 1927 (Table I)

The ore was medium hard. Approximately 20 percent of the total tonnage was screened out ahead and by-passed the Symons crusher, and approximately 55 percent of the total tonnage was screened out ahead of and by-passed the gyratory crusher. Both units were receiving minus 10-in. grizzly product, the maximum size of slab being 10-in. by 10-in. by 18-in. and were fed tonnage up to the roll capacity.

Test of April 10, 1927 (Table II)

This test is the same as previous test, except that all Hum-mer screens were equipped with ¼-in. by ¾-in. mesh instead of ⅜-in. by ¾-in. and the ore was much harder and contained a minimum percentage of fines.

Test of February 18, 1928 (Table III)

This test on medium hard ore was run to determine, if possible, the capacity of the Symons crusher. On account of the insufficient capacity of the 72-in. by 20-in. rolls and the limited capacity of the surge bins above the rolls the test was only of 15 minutes' duration. The crusher showed no signs of choking, nor distress, while handling feed at the rate of 490 tons per hour. It was not determined, nor thought, that this tonnage was the capacity of the crusher.

In this test approximately 25 percent of the original feed was screened out ahead of and by-passed the crusher, the 490 tons mentioned above being the total feed to the unit. The crusher was set to ⅜-in. opening, and the maximum size of the feed was the same as in the previous test. The screens ahead of the crusher were ¾ in. by 1½ in. Average power imput to the motor was 134 K. W.

The remarkable performance is shown by the screens in Table III.

The screen analyses shown were made using square mesh screens on the coarser sizes. It is estimated that 90 percent of all material shown on 1 in. and ¾ in. would have passed through a screen with a rectangular opening of 1 in. by 2 in. or ¾ in. by 1½ in.

FINE CRUSHING DEPARTMENT

Early in 1926 two 8 ft. by 6 ft. Marcy ball mills were coupled together and made one 8 ft. by 12 ft.-rod mill. This mill, charged with 52 tons of 3-in. rods, operates in open circuit at 13.4 r. p. m. and until the recent installation of additional classifiers was followed by three 7 ft. by 10 ft. ball mills at 16.5 r. p. m. in closed circuit with two 8 ft. D. S. D. Duplex Dorr classifiers with 15-ft. bowls. All other mill sections, see figure No. 3, consisted of two 42 in. by 16 in. Garfield rolls in closed circuit with eight impact screens covered with 8-mesh, .032 wire, and one 38-in. elevator followed by three 7 ft. by 10 in. ball mills at 19.9 r. p. m. in closed circuit with two 8 ft. D. S. D. Duplex Dorr classifiers with 15-ft. bowls. Table IV shows the comparative performance of the rolls and rod mill.

With finer crushing in the coarse crushing department and in view of the simplicity and ease of rod-mill operation, with the resulting improved cost of finer grinding all mills sections are being equipped with rod mills instead of rolls for primary grinding, and, as shown in figure No. 4, additional classifiers are being installed, for finer secondary grinding, using a minimum of 12 ft. of rake width per ball mill.

The SUPPLY DEPARTMENT

By A. J. MacLean *

Managerial Attention To Elimination Of Wasteful Methods And Reduction Of Costs Largely Responsible For Progress In Mining Industry—Supervision And Control Of Supplies—Classification, Turnover, Surplus And Obsolete Supplies Discussed

PROGRESS in the mining industry during the last two decades has been largely due to managerial attention to elimination of wasteful methods and reduction of costs. Careful analysis has of necessity taken the place of the indifference that formerly existed, as profits now must be made from a much leaner gross profit than in the days of high-grade ores. Few so-called bonanzas have been discovered of recent years, and today's successful enterprises are in large part the rejects of former times.

Accounting, once thoroughly despised by a majority of mining men as unessential, has now an important place in the industry, and the improvement of accounting methods is no less marked than the progress in mining and metallurgy. The management of today keeps a wary eye on expenditures and costs and looks to the accounting department for a proper presentation of facts; dividends to be paid must be earned.

It is axiomatic that complete costs fall naturally into three classes:

(1) Labor.

(2) Supplies consumed.

(3) Administration or overhead expense.

This discussion is confined to the second class, and the work of the supply departments, the organizations that have the control of supplies at the points of operations, as distinguished from the division in charge of purchasing.

The supply department functions in a dual capacity. It is responsible to the management through the accounting department for supply values, and to the operating department for the maintenance of adequate stocks. Needless to observe, the latter is the more important duty, as operating costs would be greatly impaired by neglect in that respect.

The duties of the storekeeper may be summarized as follows:

(1) Ordering, (2) receiving, (3) storing, (4) pricing, (5) issuing, (6) recording, (7) inventorying.

Volumes could be written on each of these divisions, so this paper will be restricted to one or two matters that may be of interest to those concerned.

Supervision and Control of Supplies

Clerical work in the handling of supplies should be reduced to a minimum. With the development of "systems," clerical work has materially increased, in many cases to an extent absolutely unjustified by the results obtained. So far as the supply department is concerned a stock clerk who handles the supplies in person is many times more

* General Purchasing Agent, Utah Copper Company, Salt Lake City, Utah.

General view of mine of the Utah Copper Company, Bingham, Utah

valuable than a clerk who may never see the material and who may not know the difference between a hacksaw and a crosscut saw. This increase in clerical forces is due chiefly to the so-called perpetual inventory system, which requires a book entry of each individual item of material, in and out. These records are not reliable as a general thing, and few storekeepers would depend on them alone for the control of stock. Requisitions may be lost or may never be made at all when rush repairs have to be made at night, and the record remains incorrect until a physical inventory is taken, when adjustments must be made.

I do not suggest that the perpetual inventory system should be entirely discarded, but a modification is desirable. Experience of many years has demonstrated that about 85 percent of the total value of supplies issued entails only about 10 percent of recording time and expense. These are supplies used in bulk, such as timber, explosives, fuel, reagents, etc., and 90 percent of recording time and expense is devoted to about 15 percent of supplies value, such as shelf hardware, tools, pipe fittings, etc.

The supplies generally can be divided into two classes:

(1) Supplies used in bulk not housed in warehouse.

(2) Supplies housed in warehouse.

Supplies of the first class are few in number compared with the total classification of supplies carried and are easily checked. Good practice demands that this class of material should be verified and adjusted frequently; in other words, a physical inventory should be taken every month, as operations depend mostly on this class of material. A perpetual inventory record should be maintained for these; the requisitions accumulated and totals posted monthly to the record.

In a properly arranged warehouse the second class of supplies do not require a perpetual running inventory record. With the modern bin and tray method of storing, the supplies are constantly under the observation of the storekeeper and card or book entries are not necessary. Frequent counts of warehouse stock is a good education for stock clerks, and the record clerk, with the infinite care required of him, is unnecessary. This is not a novel or untried system, as several of the large railroads are operating their supply departments in this manner.

Prices for supplies of the first class are maintained in the usual way on the perpetual inventory record. For supplies of the second class bin tags are used which show the price per unit in addition to the description of the material. The card tag for shelf and bin stock is of the customary form used for the description of the material, with a space added to show the price per unit. The tag for material carried in bundles, bales, reels and coils is similar except that it is of the baggage check form and tied to the stock.

Prices are changed as supplies are renewed, so by this method the prices are always up to date, and the attendant or issuing employe knows the cost of the items and can price the requisitions at the time the material is delivered. The elimination of a second handling of requisitions for pricing, made necessary when separate price records have to be consulted, is a decided advantage, and this method also facilitates inventorying.

The baggage-check form is used to assist in re-ordering important special material or equipment. A tag of a particular color is assigned to such supplies, and in addition to the description and price the order number is added. When such material is issued the tag is returned to the storekeeper and he immediately orders replacements, the tag facilitating his work to the extent of directing him to the previous order.

A great deal of discussion has arisen with respect to pricing. Some advocate the "first in" method, others favor averaging prices, but for service supplies carried for operations there is no need for such precision. It is simpler to use the latest price and the law of averages will do the rest. All who have had experience with mining supplies know that the supply values are more likely to vary from causes other than pricing.

It may be necessary for the merchant to keep an absolutely accurate record of supplies on hand, because these are his stock in trade or products, but in the mining business material and supplies are not elements of the finished product but only aids to production—no more important than operating equipment used in the production process. The practice of preparing extensive and elaborately itemized inventories of material and supplies serves no useful purpose. By the time they can be prepared the values have changed and the material has changed also. A much more accurate control may be exercised as here suggested, discarding the annual complete check with the discouraging grind of extra work that accompanies it. From an audit point of view the annual inventory is superficial. It represents the book value of supplies on a certain date, and means no more than would an appraisal of the operating machinery and equipment on a given date.

Supplies are only current assets to the extent of their usefulness, and there is a fixed investment always which is subject to depreciation at the close of operations. The cost of supplies plus transportation can rarely be realized in liquidation.

Classification of Supplies

The classification of supplies is too often a matter of haphazard development with the result that the routine work of the supply department instead of being an aid to the cost assembly and operating departments is quite the reverse. A carefully planned classification is essential to good cost accounting. Each department of the industry — mining, milling, smelting and the subsidiary operations, such as shops, foundry, power plant, etc., use certain supplies of particular importance to its cost of operation, and the supply department's classification should be arranged to help the process of cost finding. While for warehouse convenience and control of stocks the classification may be divided into many commodities, these oftentimes must be regrouped at the expense of additional labor for cost reports, whereas a suitable arrangement of classification in the first place would obviate that. The supply department should know what supplies each operating department is chiefly interested in month by month for comparative purposes, and provide a classification that will group the commodities in the way desired. In brief, the classification should arrange itself for the convenience of the cost accounting, as it is just as easy to make the records in that way as another.

Reconciliation of Accounts

A close accounting relation must exist between the supply department and the general accounting department. As usually organized, the accounting department makes payment for the supplies and transportation costs and charges a general controlling account with such expenditures. Supplies issued during the month, as reported by the storekeeper, are credited to this account, so in theory the balance in this account should represent the inventory value of supplies on hand. In practice this rarely obtains by reason of the necessity of paying invoices before arrival of goods to secure discounts. Differences of this kind should be reconciled monthly, following the manner used in verifying accounts with banks, and to do so a system of transmittal reports between the two departments is essential. The storekeepers should for convenience in making these reconciliations also keep a control record something like shown in Table I.

The statement illustrated there shows that the supply department is responsible at January 31 for $94,500 of supplies, whether in possession or in transit, and the subsidiary accounts represented by the supply classification of commodities must total that amount. A reconciliation should accompany the storekeeper's monthly report of stock balances to confirm to the accounting department

that the books of the supply department are in agreement with the general ledger controlling account.

Surplus and Obsolete Supplies

Surplus stocks under modern storekeeping methods seldom accrue from overbuying but are due chiefly to obsolesence. Changes in operating equipment and practice leave supplies on hand that can not be used to advantage, and unless disposed of they remain dormant to swell the investment in supplies unduly. These supplies can rarely be sold at their book value, and as they are useless as current usable material the difference between the book value and disposal value is depreciation that should be recognized and adjusted if the supply department's balances are to be truly representative. It is commonly the custom to report such material to the department having charge of selling it, but the supply accounts do not show the value of this obsolete material in a manner easily discernible by the management. To correct this it is suggested that an account "Surplus and Obsolete Supplies" be added to the supply department's classification. As soon as supplies become obsolete they should be credited at the full book value to the class in which they have been carried and charged to the surplus supplies account. In this manner the storekeeper's accounts and monthly reports will show the value carried in surplus material and will show the trend up or down and indicate the progress made in disposing of the material. Surplus material should be removed from current stocks and stored separately for convenience in inventorying.

Turnover of Supplies

The amount of the necessary investment in supplies naturally varies with the rapidity of turnover, and it is desirable to get the highest rate commensurate with the safety of operations. In the mining industry the rate is extremely variable, chiefly on account of geographical location. Some properties are situated in proximity to commercial centers where the supplies may be readily replenished, while others are situated unfavorably and must carry greater stocks to guard against the interruption of operations. Wherever situated it is desirable to observe the rate of turnover and its relation to other factors as it is an index to the trend of the investment in supplies.

While rapidity of turnover is desirable in the mining business no less than in any other, it does not follow always that a low rate is uneconomical. The properties must maintain standby stocks of material which affects turnover. When the investment in supplies per annual ton of ore treated is constant a low rate of turnover is desirable from a managerial point of view as it indicates a reduced cost for supplies consumed. The rise or fall of turnover, in conjunction with the investment per annual ton or other unit of production provides comparisons that are useful. The form of report suggested should be prepared monthly and each month covers a year's performance. This report is readily prepared, as it may be brought up to date by adding the thirteenth month's business and dropping the first month's. In this manner the trend is shown continuously. See Table II.

For the purpose of this discussion the figures in the report illustrated have been somewhat exaggerated. It is shown that the investment per annual ton has been almost constant, and the turnover has receded from a rate of 1.91 for the year ended January, 1927, to a 1.3 rate for the year ended December, 1927. Looking casually at this report one might surmise that the stocks of supplies were increasing and that something was the matter with the supply department. As a matter of fact, the lower rate indicates that this concern is operating closely to its "standby" supplies minimum and that there has been a marked reduction in the cost per ton for supplies compared with the year ended January, 1927.

The cost per annual ton for the year ended January, 1927, was 1.91 times 31.29, or 59.76 cents per ton.

The cost per annual ton for the year ended December, 1927, was 1.305 times 29.91, or 39.05 cents per ton.

An unfavorable condition is indicated by an increase in the rate of turnover combined with an increase in investment cost per annual ton. If the turnover rate decreases and the investment per ton remains constant, conditions are improving from an operating point of view. The ideal condition is a low investment per ton and a high rate of turnover. A report of this character should be of interest to operating officials who wish to note the trend of investment in supplies.

In conclusion, it seems fitting to stress the importance (*Continued on page* 708)

TABLE I

STOREKEEPER'S SUPPLIES CONTROL ACCOUNT

Date		Items	Debit	Credit
Jan.	1	Inventory this date	.....	$100,000
	4	Discounted invoices, Transmittal Sheet A-1	.....	5,000
	8	Invoices forwarded for payment, T/S B-2	.....	10,000
	12	Invoices forwarded for payment, T/S B-3	.....	7,500
	20	Discounted invoices, T/S A-2	.....	3,500
	28	Transportation charges, T/S B-4	.....	2,500
	31	Invoices for payment, T/S B-5	.....	6,000
	31	Issues for month per storekeeper's report	$40,000	.....
	31	Balance, General Books	94,500	.....
			$134,500	$134,500

TABLE II

STOREKEEPER'S MONTHLY REPORT OF TURNOVER

	Purchases A.	Issues B.	Monthly Inventory Balances C.	Tons Ore Treated D.
1. Eleven months, January, 1927, to November, 1927	$500,000.00	$510,000.00	$4,750,000.00	1,300,000
2. December, 1927	55,000.00	48,000.00	380,000.00	129,000
3. Totals for 12 months	$555,000.00	$558,000.00	$5,130,000.00	1,429,000
4. Average inventory during period (C divided by 12)				$427,500.00
5. Rate of turnover of supplies (Total B divided by Item No. 4)				1.305
6. Supplies inventory in cents per annual ton (Item 4 divided by Total D)				29.91
7. Supplies purchased in cents per annual ton (Total A divided by Total D)				38.84
8. Supplies issued in cents per annual ton (Total B divided by Total D)				39.05
9. Increase percent				None
10. Decrease percent (39.05 minus 38.84c=0.21c)				0.54

STATISTICAL

Year Ended		Turnover Rate Item No. 5	Investment Per Ton Item No. 6	
This month	December, 1927	1.305	29.91	as above
	November, 1927	1.33	30.37	
	October, 1927	1.60	30.80	
	September, 1927	1.65	31.20	
	August, 1927	1.65	31.79	
	July, 1927	1.65	32.81	
	June, 1927	1.68	31.63	
	May, 1927	1.72	31.40	
	April, 1927	1.81	31.30	
	March, 1927	1.85	30.95	
	February, 1927	1.87	31.17	
	January, 1927	1.91	31.29	

The MINE MANAGER'S COST CONTROL PROBLEM

By T. McGRATH*

Cost Control Is The Mobilizing Of All The Facts Of The Business And Utilizing Them So As To Get The Lowest Possible Present Cost With The Largest Possible Ultimate Profit

IN presenting the subject of "cost control," it is appropriate, first, to discuss the object of "mine management." If the mine is in the prospect or development stages, the objective is to operate at the least possible cost that will bring the mine to the production stage properly developed and equipped.

If the mine is in the production stage, the objective is to obtain the largest ultimate profit from the property with as little detriment to the community as is practicable.

A mine differs from an ordinary business in many ways. When a mine prospect is started, it is considered simply a speculative venture. As ore is found and is developed in commercial quantity, a decision is reached as to what should be the capacity and grade of the mine. The mine equipment of a certain capacity and suitable for the character of ore developed is installed, and the life of the mine is theoretically determined.

If the tonnage and grade of ore prove to be equal to or better than estimated, and the expected market price of metals, materials and labor are obtained, the manager has only the problem of holding the production cost down to the estimated cost in order to get the expected profit.

However, if the grade or tonnage of ore, or price of metals, prove to be less than estimated, or the price of materials or labor prove to be higher, then means must be devised to offset the differences, or at least to prevent operating at a loss, if it is possible.

When a mine has reached the production stage, it is equipped for a certain capacity and an estimate is made of what the production cost should be operating at the equipped capacity, and a system of cost accounting is established that will keep the management advised as to what are the actual costs of production and of each department of the organization.

Cost Control

Cost control is the means of ascertaining whether or not there is being obtained the costs and the ultimate profit that was estimated should be obtained, and whether the current results are the best obtainable.

Cost accounting does not obtain or control costs; it is simply the means by which the going costs and profit or loss are ascertained.

In substance, cost control is the mobilizing of all the facts of the business and utilizing them so as to get the lowest possible present cost with the largest possible ultimate profit.

In order not to exceed the time allotted to this subject, it will be necessary to limit the facts to be presented to some one class of mining.

The data submitted will be that applicable to copper mining and principally to underground mines producing direct smelting and milling ores, containing, as a by-product, precious, or other metals, of sufficient value to require consideration in determining the method or methods of mining.

The principal factors necessary to maintain an intelligent cost control of operations are:

(a) Ore minimums.
(b) Economical ratio of concentration.
(c) Daily check.
(d) Monthly costs.
(e) Monthly and yearly cost comparisons.
(f) Verification of working conditions. (Personal contact; engineer's report.)
(g) Fixing responsibility and credit.

Mines Producing Low-Grade Milling Ore

The low-grade mines producing ore on a large scale, of a milling grade only, have, as a rule, before production is started—

(a) A measured tonnage.
(b) Of a definite uniform grade of one metal only.
(c) To be worked by a certain system.

Therefore they are dependent mostly upon volume, improved methods and management in order to reduce costs and obtain better than estimated results. In such mines the grade of ore rarely varies more than 5 pounds per ton of ore mined, and the by-products of rare or other metals are usually too small to be of interest as far as mining methods are concerned. The principal problem is to obtain 100 percent of the estimated tonnage and grade without increasing the estimated production cost.

Mines Producing Smelting Ores

Mines that produce direct smelting ores endeavor to maintain a certain average grade and a certain daily tonnage to the smelter. Such mines produce ores from many separate ore bodies containing values in more than one metal. The grade of ore in the different stopes is seldom uniform, and the grade from each ore body will fluctuate widely as stoping progresses. Usually more than one method of mine stoping is used. It is necessary to know from month to month what is the minimum grade that should be mined and shipped without incurring a loss. Otherwise, to maintain a certain tonnage, unprofitable ore will be mined and shipped with profitable ore, decreasing the profit that should have been obtained from the profitable ore.

Ore Minimums

In mining direct smelting ores it is usually necessary to determine minimums for three classes of ore:

(1) Minimum for prospect ore.
(2) Minimum for prospect ore being developed by stoping.
(3) Minimum of stoping ore.

An example of minimums for prospect ore found in exploration work is shown

* Shattuck-Denn Copper Company.

Table No. 1—MIMIMUM FOR PROSPECT ORE FOUND IN RAISES, CROSSCUTS, ETC.

(This is based on metal prices as of January 1, 1927)

With gold assay of .00 and silver of .00 oz., copper must be more than 2.50%
With gold assay of .00 and silver of .50 oz., copper must be more than 2.50%
With gold assay of .03 and silver of .50 oz., copper must be more than 2.20%
With gold assay of .03 and silver of 1.00 oz., copper must be more than 2.10%
With gold assay of .03 and silver of 2.00 oz., copper must be more than 1.80%
With gold assay of .03 and silver of 3.00 oz., copper must be more than 1.60%
With gold assay of .03 and silver of 4.00 oz., copper must be more than 1.30%
With gold assay of .03 and silver of 5.00 oz., copper must be more than 1.00%
With gold assay of .03 and silver of 6.00 oz., copper must be more than .80%
With gold assay of .03 and silver of 7.00 oz., copper must be more than .60%

The ores seldom run more than 3 oz. gold, but if the gold is more than .03 oz. than .01 oz. gold equals .1% copper.

If the grade is better than above, you will get some money back from the smelter. If the grade is lower, we will have to pay the smelter something for smelting.

The only thing that will change the minimum for development ore is the price of metals. The prices used in above figures were: Silver. at 53 cents per ounce; copper, at 13¼ cents per pound.

Table No. 2—MINIMUM FOR PROSPECT ORE BEING DEVELOPED BY STOPING

(This is based on metal prices as of January 1, 1927, and on an average stope cost of $3.50 per ton)

With gold assay of .00 and silver .00 copper must be more than 4.25%
With gold assay of .00 and silver .50 copper must be more than 4.25%
With gold assay of .03 and silver .50 copper must be more than 4.00%
With gold assay of .03 and silver 1.00 copper must be more than 3.80%
With gold assay of .03 and silver 2.00 copper must be more than 3.50%
With gold assay of .03 and silver 3.00 copper must be more than 3.20%
With gold assay of .03 and silver 4.00 copper must be more than 2.90%
With gold assay of .03 and silver 5.00 copper must be more than 2.60%
With gold assay of .03 and silver 6.00 copper must be more than 2.30%
With gold assay of .03 and silver 7.00 copper must be more than 2.00%
With gold assay of .03 and silver 8.00 copper must be more than 1.70%
With gold assay of .03 and silver 9.00 copper must be more than 1.40%
With gold assay of .03 and silver 10.00 copper must be more than 1.10%
With gold assay of .03 and silver 11.00 copper must be more than .80%
With gold assay of .03 and silver 12.00 copper must be more than .60%

Each .01 oz. gold equals .1% copper.

If cost of stoping is more or less than $3.50, the minimum would go up or down; $1.00 of expense equals 10 lbs., or .5% of copper. This minimum is based on silver at 53 cents per oz. and copper at 14¼ cents per lb. If copper or silver go up or down, the above minimums would go up or down.

You can take your stoping cost from the stope cost sheet for previous month to guide you in the current month. If any prospect ore is costing $3.50 per ton to stope, then the minimums above are all right on present metal prices. If stoping cost is $2.50, or $1.00 less, then your minimum for copper would be .5% less. For every .01 of an ounce that the gold assay goes above .03, you can lower the copper minimum .1% copper. For instance, if you have gold content of .13 oz., your copper minimum would be 1% less, as follows:

Gold	Silver	Copper
.03	2.00	3.50%
.13	2.00	2.50%

Table No. 3—MILL ORE—MINIMUM OF ORE TO BE STOPED

(Price of lead, 7.8 cents; price of silver, 53 cents; average stoping cost, $2.80)

If ore from stopes is less than grades show below, we make money if we gob it. Better still, if we can do so, leave it until we get better metal prices.

With gold assay of .00, silver .00, lead assay should be better than 7.0%
With gold assay of .00, silver 1.00, lead assay should be better than 7.0%
With gold assay of .02, silver 1.00, lead assay should be better than 7.0%
With gold assay of .05, silver 1.00, lead assay should be better than 6.7%
With gold assay of .05, silver 2.00, lead assay should be better than 6.3%
With gold assay of .05, silver 3.00, lead assay should be better than 5.9%
With gold assay of .05, silver 4.00, lead assay should be better than 5.5%
With gold assay of .05, silver 5.00, lead assay should be better than 5.1%
With gold assay of .05, silver 6.00, lead assay should be better than 4.7%
With gold assay of .05, silver 7.00, lead assay should be better than 4.2%
With gold assay of .05, silver 8.00, lead assay should be better than 3.8%
With gold assay of .05, rilver 9.00, lead assay should be better than 3.4%
With gold assay of .05, silver 10.00, lead assay should be better than 3.0%
With gold assay of .05, silver 11.00, lead assay should be better than 2.6%

Anything less than 2.5% lead, and more than 11 ozs. silver should go into the 3-sticks, or silicious ore bins.

Each .01-oz. gold content equals 0.15% lead.
Therefore .10-oz. gold content equals 1.50% lead.

If you have gold content of 0.15 oz. your lead minimum would be 1.5% less, as follows:

Gold	Silver	Lead
0.05 oz.	4.00 ozs.	5.5% equals
0.15 oz.	4.00 ozs.	4.0%

Also each 0.05 oz. gold equals 2.0 silver. If you have gold content of 0.10 oz., your silver minimum would be 2.0 ozs. less, as follows:

Gold	Silver	Lead
0.05 oz.	4.00 ozs.	5.5% equals
0.10 oz.	2.00 ozs.	5.5%

Table No. 4—MONTHLY SUMMARY OF MINE COSTS PER TON, EARNINGS, ETC.—YEAR 19—

	January
Stoping	$3.052
General mining	2.049
Maintenance shaft, drifts, etc.	.524
Exploration and development	1.116
Mine overhead	.906
Mine transportation	.238
Total mining cost	$7.744
Wet tons mined	26,442.52
Tons stoped per man shift	2.70
Dry tons smelted	25,088.73
Percent moisture	4.56
Pounds copper recovered per ton	128.472
Gold and silver values per ton	$5.296
Operating profit per ton	$7.80
Operating loss per ton	.....
Price of copper used	$.13
Price of silver received	$.6740
Feet of drifting	5,306
Feet per man shift	1,425
Feet of raising	1,938
Feet per man shift	1.01
Wet tons ore per foot development	3.65
Development cost per foot	.....

Table No. 5—MONTHLY SUMMARY OF PRODUCTION COSTS PER POUND, EARNINGS, ETC.—YEAR 19—

	January
Mine copper production	.060
Copper ore freight	.002
Copper ore smelting	.029
Bullion freight and refining	.019
Selling	.002
General overhead	.003
Operating production cost	.115
Production credits	.046
Net operating production cost	.069
Estimated value production	.130
Operating profit (estimated)	.061
Pounds copper recovered	3,223,209
Ounces gold, recovered	1,348,580
Ounces silver recovered	157,124
Pounds copper per ton	128.472
Ounces gold per ton	.054
Ounces silver per ton	6.263
Percent moisture	4.557
Dry tons smelted	25,088.732
Total operating profit	$195,791.95
Total operating loss	.....
Price of copper used	.13
Price of silver received	67.40

Table No. 6—COMPARATIVE RESULTS OF PERIODS A AND B

During Period "A," tons per man was the objective.
During Period "B," the greatest profit per ton was the objective.
During Period "A," no selective mining was done.
During Period "B," all ore was selectively mined.
Period "B" covers a length of time 2/3 greater than "A."

Operating profit on copper @ 13 cents...	349,854.00	211,274.81	Loss
Operating profit on lead and silicia ores @ market	162,706.32	196,278.57	Loss
Total profit	512,560.32	407,553.38	Loss
Dry tons copper treated	87,531	135,523	
Pounds copper recovered	11,526,414	13,567,948	
Cost per pound	9.96c	14.56c	
Dry tons lead and silica treated	222,921	169,317	
Pounds lead recovered	21,403,218	15,006,335	
Cost per pound	7.22c	8.88c	
Price received for lead	7.99c	7.57c	
Price received for silver	66.76c	$1.06	
Feet of development	29,746.5	27,434	
Cost per foot	$9.67	$12.33	
Tons copper ore per feet development	2.94	4.94	
Mining Cost per Ton:			
Copper	$9.03	$9.34	
Lead	5.82	5.05	
Tons per Man Shift:			
Copper	2.16	2.50	
Lead	2.71	6.30	
Recovery Grade of Copper Ore:			
Ounces gold	.041	.015	
Ounces silver	3.482	2.396	
Percent copper	6.585	5.006	
Assay Content—Mill Heads:			
Ounces gold	.088	.064	
Ounces silver	5.763	5.522	
Percent lead	5.612	5.689	
Assay Content—Lead Smelting Ores*:			
Ounces gold	.092	.....	
Ounces silver	8.960	.....	
Percent lead	8.065	.....	
Percent copper	.437	.....	
Assay Content—Silica Ore:			
Ounces gold	.730	.....	
Ounces silver	7.692	.....	
Percent copper	.796	.....	

*Includes low grade lead ores sold for silica content.

by Table No. 1. It is desirable that this class of tonnage shall be small. However, if such class of ore must be hoisted, and a fair profit can be obtained above the charges beyond the mine, it is a waste to throw such ore over the dump, and is a saving in cost to ship it.

Most mines that produce direct smelting ores have ore that will not pay its way including all overhead charges. However, as the fixed overhead charges are the same regardless of tonnage, when there is a surplus capacity due to inability to mine sufficient tonnage of profitable ore, it is necessary to know what is the minimum stope grades of prospect ores that can be developed and mined by stoping. No fixed overhead is charged in determining the minimum on this class of ore. Of course, the amount of tonnage of this class of ore should not be large, but it is necessary to know just what grades of such ores can be mined without lowering the earnings on the profitable ores and still give a return on the prospect ore.

The minimums of stoping ores for each current month are usually figured on the previous month's costs and tonnage, and metal prices at first of month.

These minimums keep the mine force advised as to the tonnage and grade that must be maintained if monthly results are to show a profit.

In figuring the stope minimums the amount of exploration and development is considered as at a certain rate.

Ratio of Concentration

When the grade of ore is too low to be mined and shipped direct to the smelter and there is sufficient low-grade tonnage to justify a concentrator, such ore is mined for concentration, and the concentrates then shipped to the smelter.

Sometimes the tendency is to maintain a grade of concentrate that gives the highest recovery of metal or metals, again it is the tendency to make the highest possible grade of concentrate in order to save as much freight, smelting and smelter deductions of metals, as possible. Of course, at all times there is the endeavor to keep the concentrating cost down, and, if possible, lower the cost over the previous period.

In obtaining a reduction in concentrating cost per ton, proper consideration must be given to the net return from the concentrates produced. The reduction in the net return from concentrates may more than offset the reduction in cost per ton of ore concentrated.

Therefore the most economical ratio of concentration must be determined and be a matter of continuous check.

Daily Checks

The common practice is to rely upon costs and data compiled for each month's operation. The daily cost has proved, in most cases, to be impractical. However, it is necessary to maintain some sort of a daily check, as a month's time is too long a period and may cover up many daily leaks or losses.

There are many methods of obtaining daily checks on the mine, mill and smelter. One of the simple methods for a mine check is to give, with the least possible delay, the mine superintendent and bosses a daily statement of the results obtained in each stope showing—

(a) The name or number of each stope;
(b) The number of men working;
(c) The cars or tons of ore drawn;
(d) The cars or tons per man shift;
(e) The grade of ore; and
(f) The total cars or tons mined.

As the mine has the costs and results of the previous month which were obtained on a certain tonnage, grade and cars or tons per man, as soon as this daily report is compiled it can be seen from day to day whether the mine results are equal to, better, or less than the previous month.

In addition, two sets of daily assay sheets are furnished the mine bosses. One shows the cars and grade of ore drawn from each stope, from which it can be seen that the grade is either above or below the minimum. The other sheets give the hand samples taken prior to stoping or drawing the ore, which enable the underground bosses to maintain the grade, etc.

To insure that the assay data is reliable and that this information is given to the underground bosses with the least possible delay, the matters of sampling and assaying must be carefully and quickly done.

While the potential profit in an ore when it leaves the mine may be dissipated before the ore is processed and the refined bullion produced and sold, there can be no profit obtained from ore that is unprofitable when it leaves the mine.

Monthly Costs and Statistics

To properly operate a mine under present-day conditions and requirements necessitates the compiling of a large amount of detail costs and statistics, per operating unit, per ton and per pound of refined metal for the mine, mill and smelter, as well as to meet the demands of the governmental departments.

However, from the viewpoint of meeting the cost control problem and in order to avoid consuming too much thought and time from productive effort, it is best for the manager to compile and compare only the key factors of costs and statistics.

This data will vary somewhat in order to fit operating conditions for each class and character of mine and the method of mining and treatment of ores.

The principal factors of mine costs and statistical data that will enable the manager to know the results being obtained from month to month are shown by Table No. 4. This data, of course, is particularly applicable to underground mines producing direct smelting ores which contain precious metals as a by-product.

By studying this table in comparison with previous months he can quickly see whether or not his mine costs have gone up or down and in what department, whether the difference in mine cost per ton was due to increase or decrease in tons mined or the amount of exploration and development work done and whether the grade has changed. If so, how much. Also the operating profit per ton can be compared, and, if there is any change, whether it is in the grade, the value of precious metals, or the cost, etc.

A statement of similar character can be made up for concentrating ores.

As a cross check on operating costs as shown by Table No. 4, an analysis can be made of the elements of expense that enter into the departmental costs. Such a cross check can be made showing the cost per ton per month for the following:

Labor, supplies, power, shop and repairs, expense bills, accrued and deferred.

It is not advisable to analyze the cost elements any further for general comparison. As much detailing of the labor, supplies, etc., as can be done for the unit costs for the department heads as is found necessary to keep them advised of all fluctuations.

While a statement shown by Table No. 4 is a useful guide as to operating results at the mine, mill and smelter, it is also necessary to know the complete results on the finished product. Such a statement is shown by Table No. 5. This table shows the production cost per pound for all operating expense, and the estimated operating profit on a fixed price of metal, together with other data, which is usually considered sufficient when used with the other statements to give an intelligent picture of operation costs and results.

By compiling the above data in columnar form by months and the average for the year, the general trend of operations can be readily seen.

Verifying the Cost Data

No system of cost data can be relied upon as final proof that the best ultimate results are being obtained.

This can be verified either by a close personal contact with actual operations, or by a system of records and reports from the engineering department, or both.

Wonderful cost and earnings results may be obtained for a certain period at

the sacrifice of the life of the mine, or to be offset later by poor showings.

A system of check upon stope and development operations should be maintained by the engineering department, and this data should be recorded and reported and used in daily contacts so as to insure that sacrifices are not being made to get current good results to be lost at a later day.

Responsibility and Credit

If uniform and satisfactory results are to be obtained in costs, assuming that the operating heads are competent, responsibility and authority must be definitely placed and recognized. Also credit must be given where credit is due. The love of accomplishment and the satisfaction that comes from credit justly earned is a great stimulus to effort to solve problems.

A bonus system, where it can be used, is a means of fixing a certain responsibility, recognizing the ability of a certain person to carry out the responsibility, and gives him credit for accomplishment in the form of a fixed payment above normal compensation.

The success of any bonus plan may be due more to the satisfaction obtained by the men in having the right to exercise their own judgment and initiative to accomplish a certain result and in accomplishing the result than to the receipt of the bonus itself.

Most bonus systems eventually fail to get profitable results. The cause may be due to the attitude usually taken of considering the bonus merely a method of sale of additional effort.

Results of Selective Mining

Minimum sheet, Table No. 3, is a specimen of minimum sheets furnished to mine heads in carrying out a system of selective mining of ores of different character.

Table No. 6 shows the results of mining these ores, first, from a standpoint of volume and making two mine products, in the endeavor to get cost per ton and tons stoped per man shift, listed as period "A," while the results obtained under a selective system of mining from the same stopes on same prices for base metals and less price for precious metal of about 33 percent, mining to get the greatest profit per ton making four mine products instead of two is listed as period "B."

Two-thirds more time was consumed to get a total tonnage of 310,452 tons (in period B) of lead and copper ore, than was taken to get 304,840 tons of lead and copper ore (period A), the difference in operating results was approximately $920,000.

Under the selective system the tons per man decreased but the grade increased. The total cost per ton of ore mined does not show any appreciable increase under the selective system, due to better development costs and more efficient operation, although the cost of stoping in period "B" was from 50 to 100 percent more than in period "A."

Table No. 6 shows what was done under two different systems and the advantage of one over the other; however, no statement of costs and results can show what might have been obtained.

The engineering records show in this case that the development could have been planned and done so as to shorten period "B" sufficiently to have saved approximately $100,000 in fixed overhead expenses.

Conclusion

In conclusion, it can be stated that volume production is not applicable to all mines. In some places a system of selective mining to maintain grade of ore either to produce one mine product or more than one product will result in lower production cost and greater profit than any system of cheap stoping for volume production.

Certain classes of mines have always done selective mining. However, it is probable that there will be a greater development of selective mining in the future. It would appear that the development of volume production from low-grade mines has about reached the limit.

The miner is not in a position to pass on his increased cost of production due to increase in wages or other items of expense by increasing the selling price. Neither can he combine with others to regulate the price of metals, as the market price of base metals is practically fixed by world prices, due to production coming from all parts of the world. He must rely principally upon his own resourcefulness to wrestle the mineral from mother nature, to process and refine it, and to obtain a cost below the price that world demand may offer him.

However, he is beginning to come out from his own more or less isolated center of activity and to meet with his fellows and discuss his problems and exchange ideas. The public is beginning to learn something of the great difficulties and handicaps under which its metals are produced. In the course of time the problems of cost control and market price may be no more difficult to solve than in some other lines of industry.

THE NORTH LILY SHAFT

(*Continued from page* 698)

sides, holding them apart with stulls placed as high as possible above the wallplates, hoping to strike solid bottom before they settled enough to push the timbers down. However, the settling was so rapid that it was necessary to keep sills on the mud bottom with posts to the shaft-timbers, working down a small hole, changing posts as necessary.

Nearly 100 feet of timbering was on the move and chunks of mud and rock falling down the shaft from openings caused by the movement made it a rather wild job.

When solid limestone was reached, bearing-posts were put in and sinking was stopped until the settled shaft-sets were jacked up and straightened. This was done with machine bars and two 25-ton jacks. When this job was done and made secure, with posts from the solid ground up through the soft ground, sinking was continued to a depth of 1,240 ft. without further difficulty.

The Butte system of sinking was used—muck shoveled into a low skip holding a carload, hoisted by an auxiliary hoist and dumped into a car on the sinking cage. This method was described in detail by Mr. Druillard in the *Engineering & Mining Journal.*

The mucking and hoisting record for four men in eight hours was 116 cars. The sinking through the bad ground was done by a crew composed largely of Butte miners, who put the job over in spite of the unfavorable conditions.

THE SUPPLY DEPARTMENT

(*Continued from page* 704)

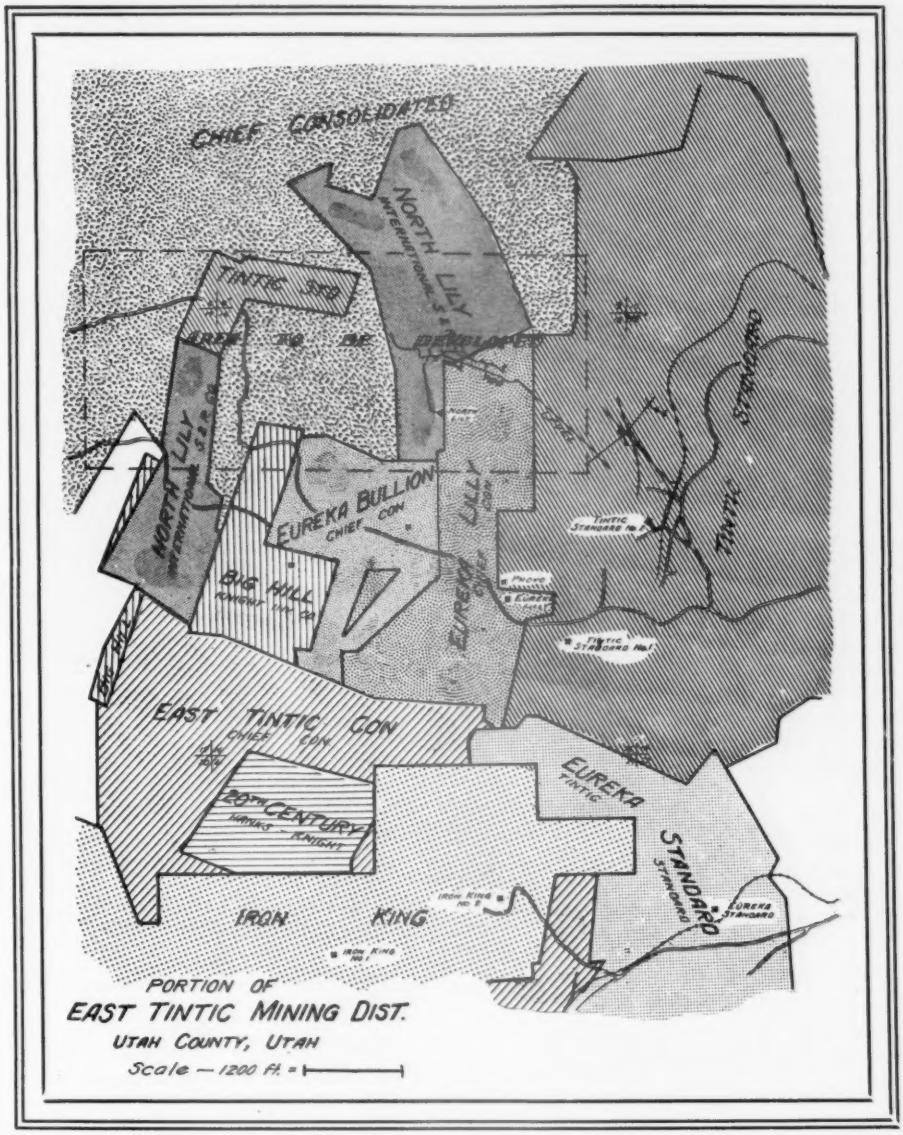
of applying practical methods to the work of the industry's supply organizations, and discard wherever possible theoretical routine that increases clerical drudgery at an expense not justified by the results. The supply organizations of the industry are, as a rule, capable and efficient and eager to do their share to promote efficiency and aid the production departments. What is often denounced as inefficiency is in many cases merely a lack of planning and coordination, readily corrected through cooperation between the supply and other departments.

MICHIGAN COPPER

The Bureau of Mines predicts substantial increases in the recovery of copper in the Michigan mining district, with a notable reduction in production costs, as a result of experiments by it in cooperation with the Michigan College of Mines and Technology. The tests indicate that the amygdaloid ores of that district may be successfully treated by the flotation process.

Among the reports published recently by the Bureau of Mines are:

Shaft Fires—Magma Mine, by E. D. Gardner and D. J. Parker. Contains particulars of fire that occurred at Magma Copper Company mine, Superior, Ariz., November 24, 1927, and presents general conclusions as to prevention of fires in metal mines.



COOPERATIVE MINING DEVELOPMENT

By JAMES W. WADE*

Duplication Of Workings On Adjoining Properties Of Differently Owned Companies Results In Economic Waste Running Into Millions Of Dollars—Cooperative Use Of Facilities And Organization Found Of Great Value In Development Of North Lily And Eureka Lilly Mines By Tintic Standard Mining Company

PROBABLY the outstanding waste in every mining district of the West is the duplication of shafts, shaft equipment, and underground workings on adjoining properties; where a single entry and its equipment would have been sufficient for the mining operation of the area. This duplication of workings on adjoining properties of differently owned companies results in an economic waste that runs into millions of dollars. It also produces an economic waste of resources because there are many ore bodies that have been rendered unprofitable by high overhead of development cost.

The gain to neighbor mining companies through cooperative use of facilities and organizations was brought into bold relief in the development operation of the North Lily and Eureka Lilly mines by the Tintic Standard Mining Company. The geological and operating aspects of this development project have been given publicity in the technical magazines, and I here

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only propose to deal with the intercompany business arrangement.

The map of the East Tintic Mining District, Utah, particularly in the area adjacent to the Tintic Standard mine, shows the ownership of the area as many parcels of ground irregularly interlocked and owned by different corporations. Added to this complication is the further one that such mineralization as was indicated on the surface passed through the properties of the various owners in a complicated fashion, end lines and side lines of the various mining claims and their prolongation into the ore body when found would have made a determination of apex rights extremely uncertain. Vertical side line agreements were made effective between the Eureka Lilly and Tintic Standard Mining Company, Eureka Lilly and North Lily Mining Company, North Lily Mining Company and the Chief Consolidated Mining Company, thus disposing of any doubt as to ownership of ore bodies when found.

Were each of the individual properties of this area developed through its own shafts it would entail development costs in excess of a million dollars. The area is one in which surface evidence of mineralization is limited, making proper location of shafts for mine operation a hazardous thing.

Geological studies of this area were begun in 1922 by geologists of the Tintic Standard Mining Company, the North Lily Mining Company, and the Chief Consolidated Mining Company. After the studies were completed it was decided that development in the North Lily, Eureka Lilly, and Tintic Standard area, as shown on the accompanying plat, was justified. Under the usual procedure both the North Lily and Eureka Lilly Companies would have been required to make an expenditure of approximately $70,000 for equipment and sinking of a prospect shaft to develop their property. Such shafts would have been located in a more or less blind manner. Had the development been unsuccessful this capital expense would have been made without chance for recovery. With successful development shafts might have been so located as to penetrate an ore body requiring for shaft safety the holding up of a valuable block of ore. It might have required the sinking of a new shaft as an operating shaft; in any event, it would have increased the cost of securing an operating shaft by repeating work in enlarging the prospecting shaft to meet operating requirements.

The Tintic Standard Mining Company had within striking distance of this area a fully equipped shaft, plant, railroad equipment, ventilation equipment, and ventilation shafts, ore bins, and a going organization. The capital expense that would have been involved for individual development campaigns was such that the complete development would not have been justified in contemporaneous programs. The management of the various companies then proposed that the development of the area be undertaken by the operating personnel of the Tintic Standard Mining Company on the basis of payment fixed at the time and set out in the following schedule:

TABLE 1—703 H-5 G DRIFT, DECEMBER, 1926—ADVANCE 625 FEET

	Amount		Cost/foot
Direct Charges:			
Labor	$3,922.15	$3,922.15	$6.28
Explosives	$1,393.16		
Rail and fittings	259.18		
Ventilation pipe	444.19		
2-in. air line	259.62		
1¼-in. air line	78.19		
General supplies	58.10		
Timber	76.62	2,569.06	4.11
Total direct charges		$6,491.21	$10.39
Indirect Labor:			
Heat, water and light, 417 man shifts, at $0.088	$36.70		
Drill sharpening, 417 man shifts, at $0.035	14.60		
Machine shop, 417 man shifts, at $0.109	45.45		
Superintendence, 417 man shifts, at $0.030	12.51		
General office, 417 man shifts, at $0.050	20.85		
Mine office, 417 man shifts, at $0.100	41.70		
General, 417 man shifts, at $0.104	43.37		
Team truck and auto, 417 man shifts, at $0.020	8.34		
Assaying, 84 assays, at $0.75	63.00		
Hoisting waste, per car, $0.36	.....		
Hoisting men, 84 per trip, $0.42	35.28		
Engineering, 625 ft., at $0.50	312.50		
Blasting caps, 1823, at $0.012	21.88		
Compressor, 28 days, at $1.50	42.00	698.18	1.12
Indirect Supplies:			
Carbide, 417 man shifts, at $0.020	$8.34		
Team truck and auto, 417 man shifts, at $0.024	10.01		
Heat, water and light, 417 man shifts, at $0.065	27.11		
General, 417 man shifts, at $0.020	8.34		
Machine drill oil, 28 days, at $0.150	4.20		
Drill sharpener oil, 28 days, at $0.150	4.20		
Mucker machine oil, 28 days, at $0.60	16.80		
Compressor supplies, 28 days, at $0.250	7.00		
Ventilation fans, oil per month, $1.00	1.00		
Car grease, per month, $3.00	3.00		
Hoisting waste, per car, at $0.060	.....		
Hoisting men, 84 trips, at $0.070	5.88		
Drill steel, per month	10.00		
Engineering supplies, 625 ft., at $0.160	100.00		
Office supplies, 625 ft., at $0.200	125.00	330.88	.53
General:			
Power compressors, 28 days, at $5.00	$140.00		
Mucking Machine, 28 days, at $2.50	70.00		
Ventilation, 28 days, at $2.50	70.00	280.00	.45
Mucker depreciation, 625 ft., at $0.50	$312.50		
Mucker maintenance, 625 ft., at $0.25	156.25		
Plant depreciation, 28 days, at $10.27	287.84		
State and county taxes, 28 days, at $1.00	28.00		
Plant fire insurance, 28 days, at $0.81	22.68	807.27	1.29
Total		$8,607.54	$13.77

Direct Charges—

Labor: All underground labor, such as miners, timbermen, timber helpers, muckers, trammers, mule skinners, ventilation men, pipe and track men, shift bosses.

Supplies: Timber, rail and pipe, explosives, ventilation pipe, etc.

Indirect Charges—

All operating expenses other than direct charges, which we prorated as follows:

Ventilation, exclusive of direct charges: Prorate on direct horsepower use (electric).

Machine drills and steel: Prorate on machine shifts.

Compressors: Prorate on machine shifts.

Hoisting: After deducting cost of hoisting men, prorate the balance on tons of ore hoisted. Prorate cost of hoisting men on man shifts underground (direct labor).

Assaying and sampling: Prorate on number of assays made.

All other indirect operating expense prorate on direct labor.

General: Plant depreciation and administration, prorate on direct labor.

Mining charge above actual cost of operation, $1.50 for each ton of ore mined.

Under Table 1 the month of December, 1926, charges and their computation is shown.

The schedule on application to the problem has been found to adequately compensate the Tintic Standard Mining Company and (*Continued on page* 715)

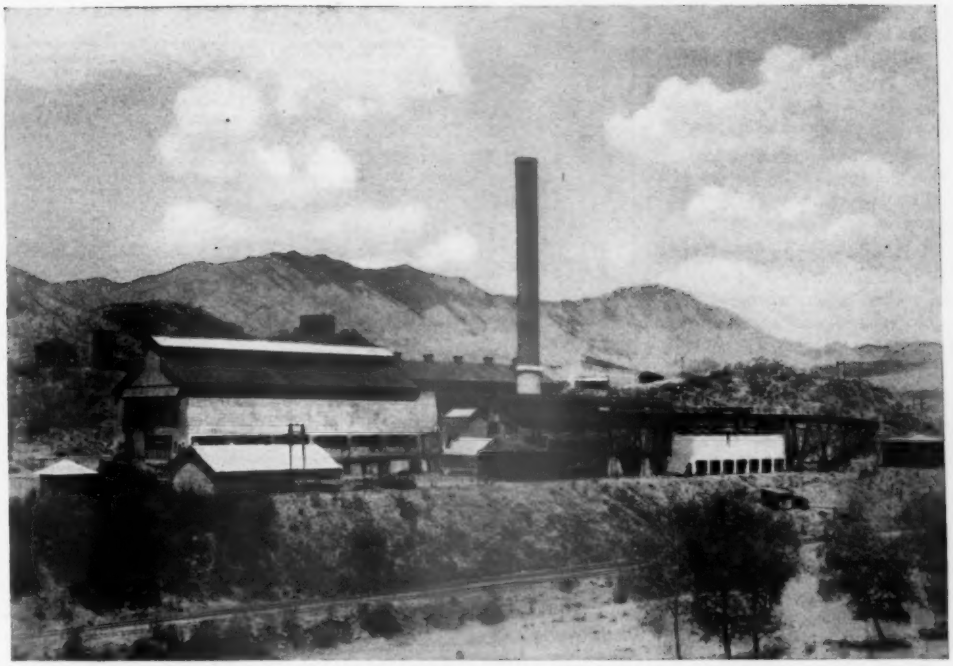


Figure 1—Phelps Dodge Diesel power plant with abandoned steam turbine plant at right

DIESEL ENGINES *as a* SOURCE *of* POWER *for* MINING

By H. H. PRATT*

First Diesel Engine Installed At Phelps Dodge Operations In 1912—Additional Units Installed Since And Twenty-Two Are Now In Operation—Used For Driving Electric Generators, Air Compressors—Fuel Consumption Tests And Operating Costs Outlined

IN 1912, when the Phelps Dodge Corporation was making preliminary plans for plant equipment at their Burro Mountain Branch, Tyrone, N. Mex., the question of using Diesel engine generating units was under consideration, and although 1,000-hp. stationary units were considered large and somewhat experimental at that time, after an investigation of European experience with these large size units, two 1,250-bhp. sea level rating, 5-cylinder engines were purchased from Carels Freres, Ghent, Belgium, and installed in the new power plant at Tyrone in 1914.

These engines are the two-stroke cycle type, with high-pressure air injection, scavenging air intake valves and scavenging port exhaust; the three-stage air compressor and scavenging pump both being driven from the engine crankshaft.

While the four-stroke cycle engine is slightly more efficient than the two-stroke cycle, the fact that the heavier, cheaper grades of fuel oil containing high sulphur content could be used in the two-stroke cycle engine without trouble was one of the deciding factors in the selection of this type of engine.

As this plant is located at an elevation of 5,950 ft. above sea level, an excess capacity scavenging pump was provided to give about 2½ pounds pressure above atmosphere in the engine cylinders at beginning of stroke in order to obtain approximately sea level bhp. output.

Mr. C. Legrand, consulting engineer, presented a paper at the September, 1916, meeting of the American Institute of Mining Engineers covering the first year of operations and giving some of the troubles experienced at this plant.

At that time there were no experienced Diesel engine operators available, and naturally most of the training of our men was obtained by experience on these engines, some of which was sad and costly, but it was evident from the results obtained and the prospect of constantly increasing price of fuel oil that the Diesel engine was going to be an important factor in our future power generation.

As demands for increased power at the various branches have come up for consideration, the Diesel engine has, in many cases, worked out to be the most advantageous type of equipment, and since the original installation of the two engines in 1914 we have installed 17 units driving electric generators and 5 units driving air compressors, making a total of 24 engines ranging in size from 750 hp. to 2,000 hp. each, and having a total bhp. rating of 31,000. Five of these units are direct connected to 100-lb. pressure air compressors, as follows:

No.	Hp. rating of engine	Variable speed	Cu. ft. capacity of air compressor
4	750	90-180	4,000
1	1,250	90-180	6,000

Nineteen of these units are direct connected to electric generators as follows:

No.	Hp. rating of engine	Speed	Kv-A rating of generator	Voltage generator
6	1,250	180	815	6,600
9	1,250	180	850	2,300
2	2,000	120	1,500	2,300
2	2,000	120	2,000	6,600

* Chief Engineer, Mechanical Engineering Dept., Phelps Dodge Corporation, Douglas, Ariz.

The apparent discrepancy between the size of generators in the last two items is accounted for by the fact that the 2,000-hp. engines were the first of this size built by the manufacturer, who had rated the engine very conservatively, and after several years' operation we determined that the engines would carry a heavier load than the generators would stand, and at one plant the cost of new generators was justified on the basis of this additional capacity.

These Diesel electric generating units are located at five different branches, two of the Diesel plants being the only source of electric power, while the other three plants are operated in parallel with steam turbine plants, which are located at various distances from the Diesel plants, and in one case 19 miles distant.

No trouble is experienced in parallel operation of several Diesel units with one or more steam turbines, although the turbine governors are usually more sensitive than the Diesel engine governors, and the turbines therefore tend to take the sharp peaks of the combined load.

Figure 8 shows one plant consisting of two 1,250-hp. and two 2,000-hp. units; the normal operation being one 1,250-hp. and two 2,000-hp. units and one 1,250-hp. unit spare. This plant is operated in parallel with a turbine plant, and when a 2,000-hp. engine is shut down for repairs the spare 1,250-hp. engine is started and the turbine plant takes the balance of the load.

Figure 9 shows a plant consisting of five 1,250-hp. power engines and a 1,250-hp. Diesel driving a 6,000 cu. ft. air compressor unit. This generating plant also operates in parallel with a steam turbine plant, and the normal operation is four engines running and one spare. The air compressor is kept in operation 16 hours a day practically all the time except for periodical general overhauling, at which time a synchronous motor-driven air compressor is run.

Figure 1 shows the exterior view with abandoned turbine plant at the right and Diesel plant at the left.

Figure 10 shows the interior view of the Diesel plant, consisting of four 1,250-hp. engines and two 2,000-hp. engines, this plant furnishing the total electric power for this branch. The normal operation is two 2,000-hp. units and one 1,250-hp. unit part of the time, leaving three 1,250-hp. units as spares. This large capacity in spare units is not required, but is available, due to the fact that the plant was installed for a considerably larger output than the present requirements.

The reliability of the Diesel engine, as compared with steam turbine or steam engine, has for a number of years been a point of argument against the Diesel engine, and some of our earlier experi-

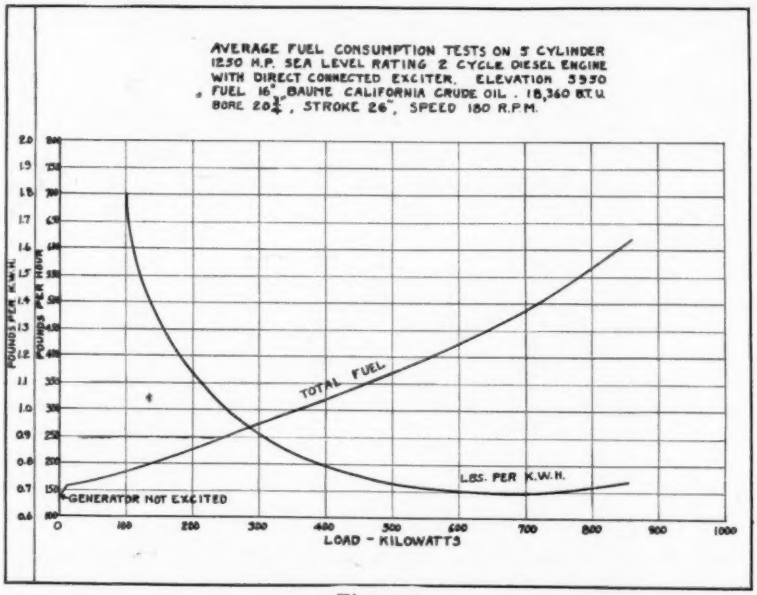

AVERAGE FUEL CONSUMPTION TESTS ON 3 CYLINDER 1250 H.P. SEA LEVEL RATING 2 CYCLE DIESEL ENGINE WITH DIRECT CONNECTED EXCITER. ELEVATION 3930
FUEL 16° BAUME CALIFORNIA CRUDE OIL . 18,360 B.T.U.
BORE 20½", STROKE 26", SPEED 180 R.P.M.
POUNDS PER K.W.H.
POUNDS PER HOUR
TOTAL FUEL
LBS. PER K.W.H.
GENERATOR NOT EXCITED
LOAD - KILOWATTS

Figure 2

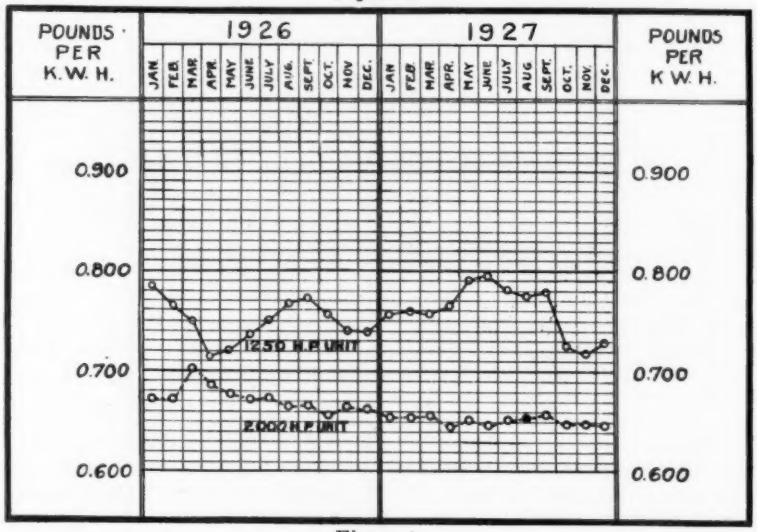


Figure 4

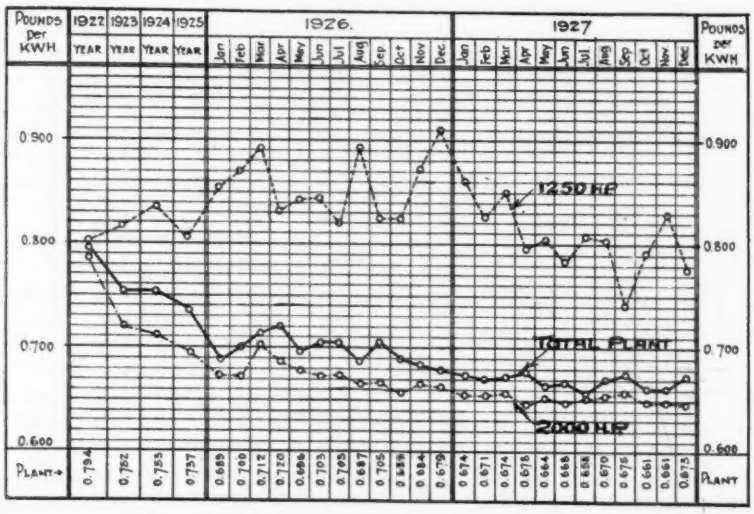


Figure 6

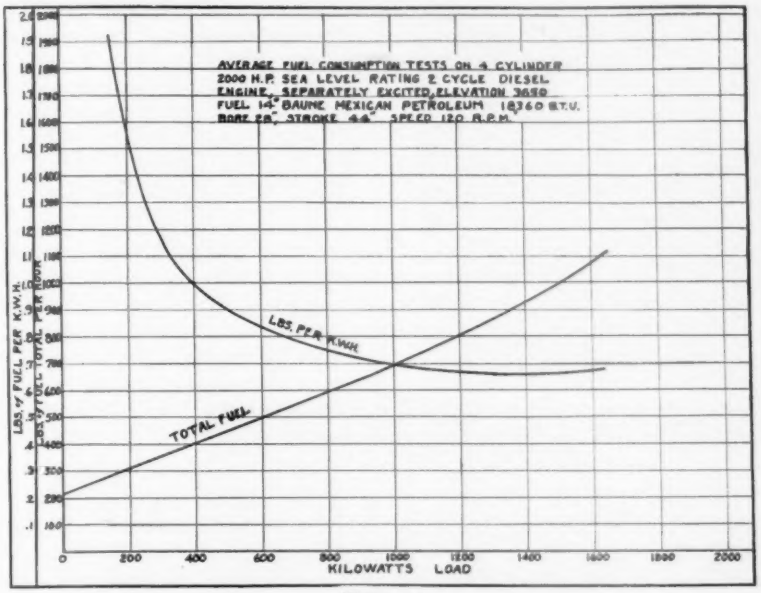

AVERAGE FUEL CONSUMPTION TESTS ON 4 CYLINDER
2000 H.P. SEA LEVEL RATING 2 CYCLE DIESEL
ENGINE, SEPARATELY EXCITED, ELEVATION 3650
FUEL 14° BAUME MEXICAN PETROLEUM 18360 B.T.U.
BORE 28" STROKE 44" SPEED 120 R.P.M.
LBS. OF FUEL PER K.W.H.
LBS. OF FUEL PER K.W.H.
LBS. PER KWH
TOTAL FUEL
0 200 400 600 800 1000 1200 1400 1600 1800 2000
KILOWATTS LOAD

Figure 3

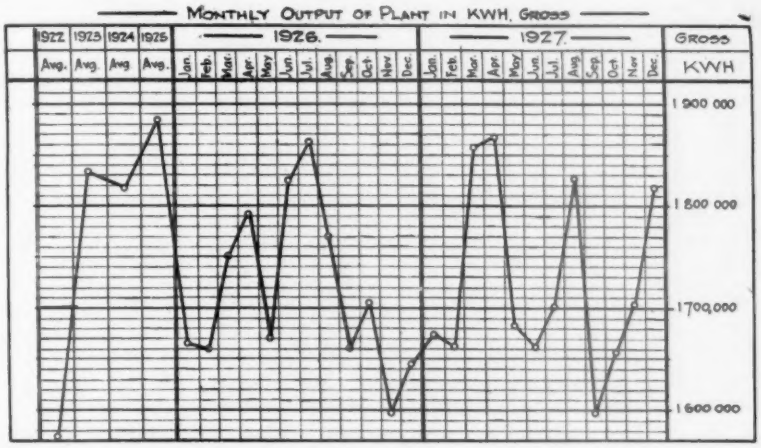

MONTHLY OUTPUT OF PLANT IN KWH. GROSS
1922 1923 1924 1925 1926 1927 GROSS
Avg. Avg. Avg. Avg. Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec KWH
1 900 000
1 800 000
1700,000
1 600 000

Figure 5

ANALYSIS OF COSTS — 1927

ITEM	MONEY EXPENDED. 1927	1926.	1925	PERCENT OF TOTAL. 1927	1926.	1925
Operating, Fuel-oil, Heavy $	119 336.91	120 208.38	149 094.09	72.57	69.77	70.59
" Light	2 032.97	2 192.21	4 145.27	1.24	1.23	1.96
Total,	121 369.88	122 400.59	153 239.36	73.81	71.00	72.55
Operating Labor & Supervision	19 051.62	18 641.32	19 146.09	11.59	10.82	9.06
Lubricating Oil	3 575.69	4 054.34	4 933.48	2.17	2.35	2.34
Operating Sundry Supplies	1 190.91	2 042.28	1 863.19	.72	1.18	.88
Water & Operation of Water Softener	1 611.52	1 505.59	1 957.20	.98	.87	.93
Repairs,						
Labor & Material						
1250HP Diesel No 1	716.82	322.22	1 503.29	.44	.19	.72
" " No 2	809.81	704.54	1 764.27	.49	.40	.85
" " No 3	908.55	2 297.73	2 304.72	.56	1.30	1.10
" " No 4	782.03	1 303.68	2 210.24	.48	.77	1.06
All E6 Type Engines	3 217.21	4 568.14	7 882.48	1.96	2.66	3.73
2000HP Diesel No 5	4 685.99	6 933.97	6 797.88	2.89	4.02	3.22
" " No 6	4 843.34	5 963.97	6 456.57	2.95	3.46	3.06
All FH Type Engines	9 529.33	12 897.94	13 254.45	5.80	7.48	6.28
Total Diesel Repairs	12 746.54	17 466.08	21 136.93	7.76	10.14	10.01
All other Plant & Building Repairs	2 881.71	3 522.46	5 604.55	1.75	2.04	2.66
General Dept Exp (Overhead & Supply Charges)	1 962.28	2 799.64	3 323.91	1.19	1.60	1.57
Incidental Expense	46.76			.05		
TOTAL. $	164 436.87	172 392.27	211 195.71	100.00	100.00	100.00

Figure 7—(This figure is continued on the following page)

ences would establish a verdict for this. However, with the cooperation of the manufacturer, combined with excellent work by the mechanical and operating departments at the various branches, we have gradually cleared up a few major troubles and numerous minor ones, so that at the present time we can maintain, if necessary, a total monthly operating time of 95 to 96 percent on continuous 24-hour day basis, which is about all that can be expected of any type of machine which is maintained in good mechanical condition.

We have no direct comparison of fuel consumption between the 750-hp. size and the larger units, as all the 750-hp. engines are driving air compressors.

Chart Figure 2 shows the average fuel consumption of the 1,250-hp. unit plotted from test runs on a new engine, and chart Figure 3 shows the fuel consumption on a 2,000-hp. unit.

When allowance is made for a direct connected exciter on the 1,250-hp. unit and slight difference in generator efficiencies the fuel efficiency is about the same, but we have found in normal operation that the fuel efficiency of the 2,000-hp. unit is considerably better than the 1,250-hp. unit.

Graphic chart, Figure 4, showing the average fuel consumption per month for two years for two 2,000-hp. engines in one plant and for a plant consisting of all 1,250-hp. engines operating on about the same load rating, illustrates this.

This shows an advantage of 6 percent to 7 percent in fuel efficiency of the 2,000-hp. units after allowance for excitation and difference in generator efficiencies. We can not account for this, except for the fact that the 1,250-hp. units are much more sensitive to adjustments and wear than the 2,000-hp. units. This is indicated on the chart, Figure 3, toward the end of 1927, when a general overhauling, including new cylinder liners on the 1,250-hp. engines, is showing results.

In normal operation under the variations in load and mechanical condition of engines the fuel consumption of 16°B. California fuel oil, 18,600 B. t. u., will average .72 to .80 pound per gross k. w. h. on the 1,250-hp. units and .64 to .70 pound per gross k. w. h. on the 2,000-hp. units at an average load from three-fourths to full load.

Graphic chart, Figure 5, shows the average monthly output in gross k. w. h., and Figure 6 the average fuel consumption per k. w. h. over a period of five years at one plant where both 1,250-hp. and 2,000-hp. engines are running.

The oil consumption chart shows the consumption for each size of engine and the total for the plant.

The fuel consumption for the 1,250-hp. engines should not be considered as typi-

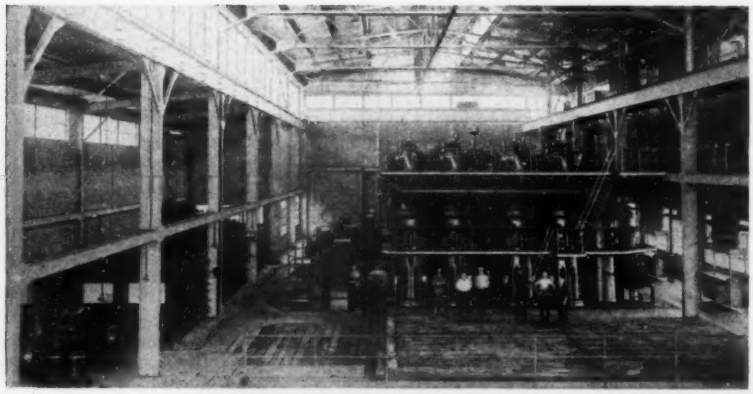


Figure 8 (above)—A plant consisting of two 1,250-hp. and two 2,000-hp. units

cal because at this plant these engines are used to make up the extra power requirements beyond the capacity of the two 2,000-hp. units and are frequently started and stopped and often run on fairly low load.

We have always used what is known as heavy fuel oil, i. e., 14°B. to 18°B. gravity at 60°F. temperature, and all the Diesel engines are provided with a double fuel supply system and started on light fuel oil, i. e., 24°B. to 30°B., and after a few minutes warming-up run are switched on to the heavy oil.

The heavy oil is all heated to a temperature between 100°F. and 120°F. and filtered before delivery to the engine fuel pumps. No expense for heating is involved except maintenance of the system, as waste heat from the exhaust gases is utilized for this, and at some of the plants heating outside the plant is also supplied from this same source.

All the engines are provided with flywheel barring device, and, due to some of our early experiences, we have an absolute general rule at all plants that an engine shall never be started without having been turned at least one complete revolution with the barring device.

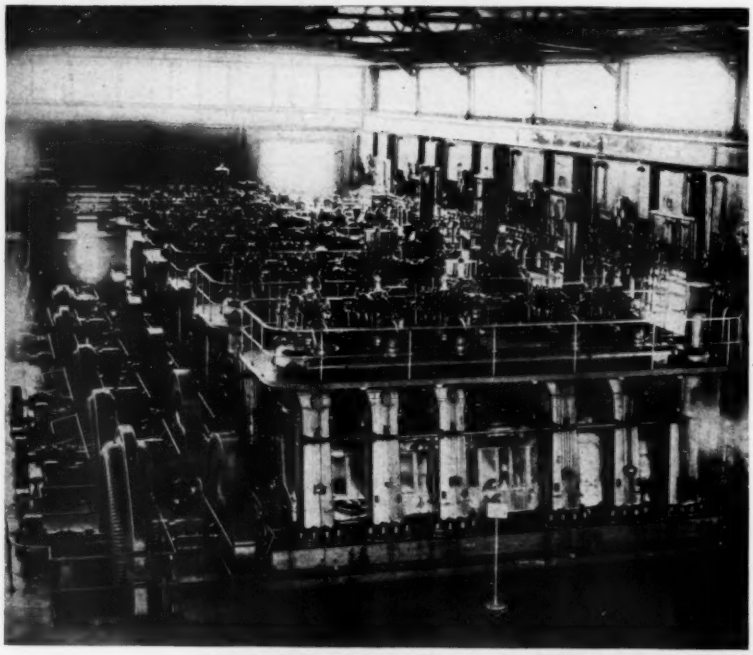
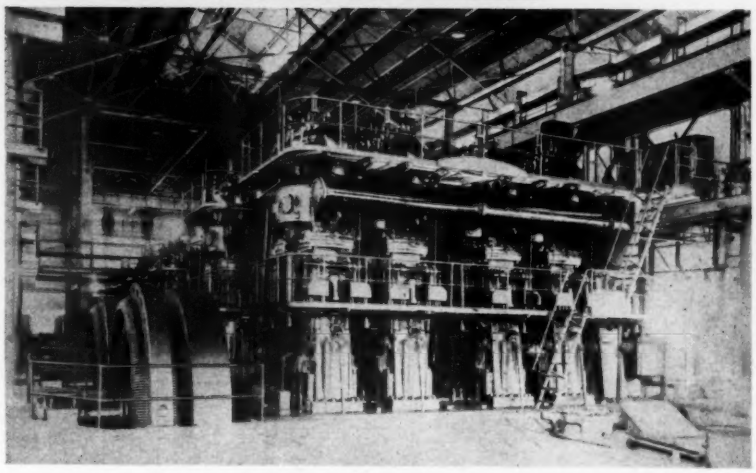


Figure 9 (left) — A plant consisting of five 1,250-hp. power engines and a 1,250-hp. Diesel driving a 6,000-cu. ft. air compressor unit

Figure 10 (below)— Diesel plant consisting of four 1,250-hp. engines and two 2,000-hp. engines



PLANT OUTPUT AND FUEL COST

Gross output.....k. w. h..	20,701,400	20,605,900	22,610,010
Used by auxiliaries.....k. w. h..	832,680	898,920	1,127,830
Net output.....k. w. h..	19,868,720	19,706,980	21,482,180
Fuel oil cost per bbl.....	$2.94	$2.86	$3.43

Figure 7—(Continued from preceding page)

One of the important items in connection with Diesel engine operation which was the cause of some of our early troubles is the cooling water system. There are numerous rather intricate water passages on a Diesel engine, and the formation of scale in some of these may cause serious trouble and at least will cause heating, loss of efficiency and increased repairs; therefore the elimination of at least a large part of the scale-forming constituents in the cooling water is necessary for successful operation.

We are using water-treating plants at all our Diesel plants except one, which, due to recent change in quality of water, will also have to be equipped with a treating plant.

In connection with the purchase and installation of Diesel engines, the following important details are frequently overlooked, which are essential for the successful operation of a Diesel plant:

Engine should be conservatively rated so that it will carry peak loads without excessive overload.

If engine is located at any altitude over 1,000 ft. above sea level, the brake horsepower output will decrease approximately 3 percent for each 1,000 ft. increase in altitude unless special provision is made for supplying necessary increased amount of combustion air.

The gravity, viscosity and quality of fuel oil will to a considerable extent determine the type of engine, and on account of variations in cost and quality from different sources of supply, the engine should be capable of operating on a wide range of fuel oils.

Fuel consumption guarantees by manufacturers should be stated in pounds of oil of definite gravity and B. t. u. per k. w. h. at switchboard at one-half, three-fourths and full load on generator, based on generator manufacturer's efficiency guarantees.

Considerable confusion and often disappointment in results has been caused by the manufacturers in stating fuel consumption guarantees in pounds per Br. hp. hr., k. w. h. per gallon of oil, k. w. h. per barrel of oil, etc., without stating the oil specifications or whether the load basis is on the engine rating or the generator rating.

The fuel consumption per Br. hp. hr. is of no interest to the customer, as no check can be made on this without considerable trouble and expense.

The cooling water supply should be investigated and necessary treatment provided for before the plant is started unless a closed system is installed, and in the closed system if distilled water or water of zero hardness is circulated it will cause serious corrosion, especially if air can enter the water.

The importance of lubricating oil is often stressed in connection with Diesel engines. As a matter of fact we have used a number of different brands and grades successfully, and while considerable care should be exercised in the selection of oil for cylinder lubrication, any fairly good grade of medium viscosity oil which will not emulsify and is readily filtered can be used for the general oiling system.

Last and perhaps most important is the selection of a competent engineer for the plant. The operation and maintenance of a Diesel engine plant is an entirely different proposition from that of a steam turbine plant, and after the first year or two of operation the maximum operating time and efficiency of the Diesel engines will depend to a great extent on the vigilance and ability of the man in charge.

As practically all our Diesel engines were installed during the World War period or shortly after, when prices for equipment and labor were at the peak, the cost of these plants would be of little interest today. At present prices the installed cost in Arizona of a Diesel plant having an installed capacity of 1,500 k. w. to 7,500 k. w. will range from $125 to $160 per installed k. w., depending on number and size of units, type of building, fuel storage facilities provided, etc. The direct operating costs, depending on fuel cost, wage scale and plant load conditions will vary from .006 to .009 cents per available k. w. h., which means per k. w. h. after deducting all plant auxiliaries, including lighting.

The table shown in Figure 7 for the plant normally operating two 2,000-hp. units and one 1,250-hp. unit part of the time gives a complete analyis of the distribution of operating costs over a period of three years, also total gross and net k. w. h. generated at this plant.

These figures can be considered as fairly typical of the distribution of costs except the item of fuel oil, which is expensive at this plant, and with the present price of fuel oil in Arizona this item will average about 65 percent of the total cost instead of the 70 percent shown at this plant.

No items of fixed charges, i. e., taxes, depreciation and general overhead are included in the operating costs mentioned above, as these must be determined for the individual plant and will vary greatly, depending on location and policy of the owner in regard to depreciation and overhead. These items are, however, of vital importance in connection with a mining plant installation and will often determine the type of plant and equipment.

As regards depreciation of Diesel engines based purely on the life of the engines, without consideration of obsolescence, 20 years can be taken as a conservative figure.

In determining the type of generating equipment for a mining plant many factors must be taken into consideration, and it is therefore difficult to make any definite statement regarding the use of Diesel engines.

With the improvements in construction and increase in size of Diesel units during the past few years and the increase in efficiency of modern small-size steam turbine plants it is much more difficult to decide which is the better investment than it was at the time most of our installations were made, but with the prevailing high price for fuel in Arizona and a contemplated plant load of not to exceed 5,000 to 6,000 k. w. the Diesel engines should be given serious consideration, especially in view of the possibility of future hydro-electric transmitted power, as the Diesel engine is ideal for a standby emergency unit with no loss of time or fuel expense for starting and stopping, and very little deterioration while standing idle, which is not true of the steam plant.

In other parts of the country where cheap fuel is available, the size of plant would largely determine the choice of equipment, but the Diesel can still show substantial savings over the steam plant in the small-size units up to 1,000 kilowatts.

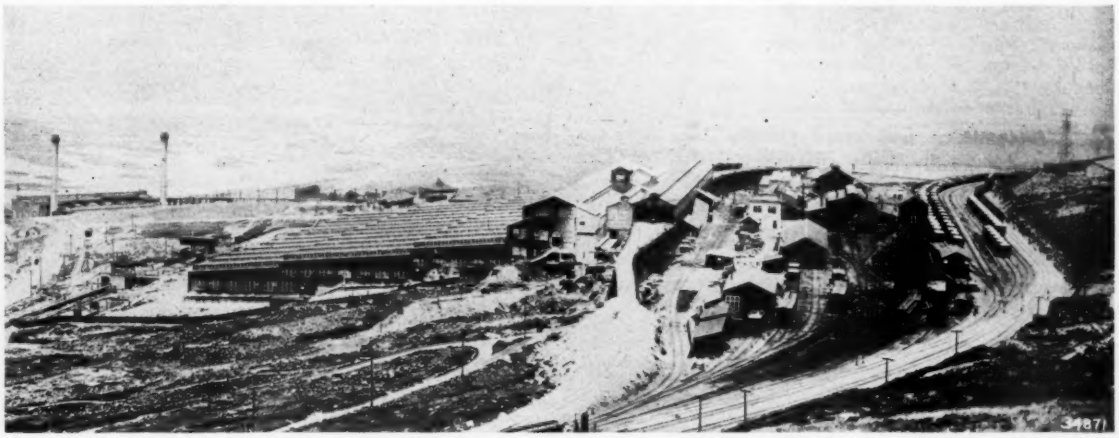
COOPERATIVE MINING DEVELOPMENT

(*Continued from page* 710)

at the same time permit the development of this area at a low cost to the other owners involved. Under this procedure the Tintic Standard Mining Company, as set out in the schedule, was able to partly write off the cost of its plant shaft and underground workings and distribute a portion of its own operating overhead against the property of its neighbors, at the same time rendering a valuable service to its neighbors.

In addition to the money saving in the development operation, each of the companies benefited materially through the close cooperation of their geologists and operating staffs during the procedure of the work. It usually happens that geological data disclosed in one property is of material value to the adjoining properties, and it proved to be so in this case. The development work of this program was expeditiously done. Beginning in September, 1926, there was completed somewhat less than a mile of underground workings by January, 1927, when profitable shipments of ore started. The time element would have made this impossible of accomplishment had a new shaft and underground workings been driven. The costs obtained showed the work was done economically, for the entire cost of finding the North Lily mine to the North Lily Mining Company was $22,000, as compared with a calculated cost that could have been anywhere between $75,000 and $100,000. Having located the position of this ore body, the North Lily Mining Company then was enabled to properly locate its own operating shaft, which has since been sunk and equipped at a cost of $146,537. In a sentence, the development hazard of capital by the neighboring companies of the Tintic Standard was reduced to at least 20 percent of the amount that would have been required had they undertaken their own development work confined within their own property, and a saving of months in time was made.

It is essential in the carrying on of this sort of a development program that the work be done by one organization and that all other interested organizations be entirely willing to submit to the final dictation of the operator who is actually doing the work. Suggestions were received, and in many cases adopted, from the operators, but in all cases the final decision rested upon the personnel of the Tintic Standard Mining Company. It is also essential that the basis of payment for services rendered be upon such a basis that all are agreed upon its fairness. That no friction developed in any department during the undertaking was largely due to the spirit of the operators and the thoroughness in which the contracts were drawn with respect to all matters of operation and payment for services rendered.



Magma Plant, Utah Copper Company — *U. S. Bureau of Mines*

PREPARATION *and* MODIFICATION *of* ORE PULPS *for* FLOTATION GRINDING

By H. S. MARTIN *

Grinding — Pulp Dilution — Modifiers And Reagents—Iron Depressors—Collectors—Frothers

GRINDING

THE first step in the preparation of ore for flotation treatment is grinding. The amount of grinding necessary must be determined for each particular ore since the object is to free the minerals from gangue, or from each other if differential flotation is desired, and also to grind the mineral fine enough to float. It is generally conceded that grinding too fine may result in poor flotation conditions, and therefore the method of grinding is usually so regulated as to produce a feed ground as near to the critical mesh as possible. With most types of ores the bulk of the flotation feed is ground to the sizes between 65 mesh and 300 mesh. A microscopic examination of the various sizes of prepared feed will show whether the minerals are practically free from gangue or free one from the other. A microscopic study of the ore and minerals before and after grinding has therefore become one of the first important steps in working out a successful treatment for an unknown ore.

In recent years the use of large classifiers in closed circuit with ball mills, and the general tendency toward the use of smaller sized balls than formerly has tended to crowd the grinding to the intermediate meshes. In making laboratory flotation tests, it is quite common to screen the feed through 100 to 200 mesh and regrind only the oversize in the laboratory ball mill. This has much the same effect as closed circuit grinding on a larger scale. The use of rod mills has increased rapidly in late years because, with the line contact of rods, most of the work is done on the larger particles and there is less tendency to produce very fine slime than in a ball mill. The general idea of most of the changes in type of grinding has been to get the bulk of the flotation feed just below the critical mesh and as little as possible in the very fine sizes.

PULP DILUTION

As in grinding, the desirable dilution or density of flotation pulp varies widely with different ores. Since the viscosity of the pulp varies with the surface exposed by the solid particles, a finely ground or slimy feed might be very viscous at 25 percent solids, and a feed composed mostly of 200 mesh sulphide minerals very fluid and watery at 25 percent solids. Primary slime, or truly colloidal material may give a flotation pulp of the best consistency at 8 to 15 percent solids and a deslimed, reground sand the ideal pulp at 40 to 50 percent solids. A pulp of too high a density gives a sticky, siliceous froth in flotation and too low a density gives a watery froth and usually poor recovery. With a given ore, reagent consumption, frother, collector and modifiers, varies directly with the amount of water mixed with the ore, or with the volume of pulp handled, so for economy in reagents and machine capacity it is desirable to use as little water with the feed as possible. It is frequently the case that more water is used in grinding and classification than should be economically handled in flotation and therefore it is good practice to thicken the feed in Dorr tanks and return the water removed for reuse in classification. The thickener tank ahead of flotation not only acts as a dewatering device, but also as an equalizer or surge tank so that the volume to flotation remains constant. When modifiers and other reagents are added ahead of the thickening tank, the time of contact in the thickener between the ore pulp and the reagent is often beneficial. The economical capacity of flotation machines also is in inverse proportion to the amount of water in the pulp, or to volume, and this is another reason for using as high a pulp density as possible. A machine capable of handling 300 tons per day at 18 percent solids might easily handle 500 tons of the same ore at 30 percent solids and give equal metallurgy provided that 30 percent solids did not give too viscous a pulp.

* Metallurgical Staff, Arthur Plant, Utah Copper Company.

Modifiers and Reagent

Although a few years ago acid, generally sulphuric, was the most commonly used modifier the practice has swung almost completely over to alkaline modifiers. The principal reason for this is the fact that it is generally almost impossible to separate iron sulphide from other minerals in acid circuit, but partly on account of the difficulty of handling corrosive acid pulps. Burned lime has generally been adopted as the alkaline modifier especially with copper ores, and it acts not only as a modifier but also as a depressant for pyrite. Lead-zinc plants have generally used soda-ash in place of lime, but even in lead-zinc work lime is beginning to be used. The first users of lime discovered that the alkalinity of the pulp water greatly affected flotation results, and attempted to maintain constant alkalinity by titrating the pulp water with acid of known strength, using phenolphthalein as the indicator. Considerable research work has been done very recently on the effect of hyprogen-ion concentration in flotation, and there is a growing belief that the alkalinity of the pulp water should be determined in terms of the actual hydrogen-ion concentration rather than in terms of total available alkalinity. The usual method of determining hydrogen-ion concentration for flotation work is by color comparison sets. Indicators having pH ranges from 6.0 to 13.6 are easily obtainable in sealed tubes, and the flotation water, containing the same indicator and in a similar tube is matched for color against the tube of known pH. The hydrogen-ion concentration generally used ranges from pH 9.0 to pH 12.0, the higher alkalinity being most common where pyrite is to be rejected in flotation. The theory, however, that the OH concentration alone is responsible for iron depression is probably incorrect, for this same alkalinity produced in the pulp by caustic soda will frequently show no depressing effect on pyrite. It is possible that through oxidation of the surface of the pyrite, calcium sulphate is precipitated thereon and remains insoluble as long as the alkalinity is high enough, but redissolves when the excess alkali disappears. The calcium sulphate is a substance easily wetted by water and therefore acts as a depressant. When caustic soda is used, if the same reaction takes place, sodium sulphate is formed, which is very soluble in water under any condition of alkalinity and therefore immediately dissolves off the pyrite.

The lime is usually the first reagent added to the ore, which is the logical method, since the lime is to prepare the pulp for further treatment. In most of the larger plants the burned lime is slaked to form milk of lime carrying about 20 percent solids, and the milk of lime fed into the ore. The lime has more effect as an iron depressor when added to the ball mill feed, as it is here dissolved by a minimum quantity of water and therefore gives a high concentration of free alkali until diluted with more water in the classifier. It is not advisable to use a large excess alkalinity in the feed water to flotation especially when the alkali is lime, because this gives a slow sluggish froth which is usually sticky and siliceous. The effect on the pyrite is therefore best obtained by carrying an extremely high alkalinity in the ball mill, and then diluting in the classifier so that the feed to flotation is relatively low in excess alkali. The rate of addition of the lime is varied usually by rheostats or gears on the feeder motor to meet the changes in alkalinity as determined from the flotation feed water.

Iron Depressors

The use of sodium cyanide as a depressant for iron and zinc is very general, nearly always in an alkaline circuit. Some recent research work indicates that cyanides have more effect on pyrite when the alkalinity is very low, or even slightly on the acid side or below pH 7.0, but these conclusions have been drawn mostly from work on clean ores and pure minerals. Work on copper-iron ores does not check this theory, as a pH of 10.0 or more is absolutely necessary on mixed feed, even when cyanide is used, for good iron depression. It is probable that ferrous and ferric sulphates in the ore are precipitated as basic sulphates, or hydroxides by the lime and that these precipitates absorb the cyanide in preference to the cyanide acting on the pyrite. If such ores are deslimed after grinding to 10 mesh, and all the —200 mesh slime removed, then cyanide will depress the iron at very low alkalinity. Washing out the slime not only removes the soluble iron salts, but colloidal matter that may also be a factor in the absorption or neutralization of the effect of cyanide. A high alkalinity is necessary with the colloidal matter and precipitated salts present, to protect the cyanide in its action on the pyrite. This idea then becomes an argument for the separate treatment of primary slimes and reground sands in flotation. If the copper-iron ore is classified at about 200 mesh after grinding through 10 mesh, the —200 mesh classifier overflow will contain practically no pyrite, and this material may then be treated with sulphidizing agents and powerful collecting agents for a maximum copper recovery. The deslimed sands, ground in a ball mill may then be treated with a much smaller quantity of lime and cyanide than would have been necessary on the mixed feed and better separation of the iron and copper minerals will result.

Recently very good results have been obtained on copper-iron ore by the use of bisulphites or sulphur dioxide gas fed into the pulp already made alkaline by lime. Ammonium bisulphite gives the best iron depression and copper recovery, but sulphur dioxide gas bubbled into the limed pulp at the rate of .25 to .35 pound per ton of dry ore has given as good results as .06 to .08 pound of 48 percent cyanide per ton. These reagents have not been applied as yet to large operation but have been confined to experimental work.

Theoretically, the order of addition of reagents should be lime first, cyanide or other depressor second, selector third and frother last, but actual tests show little difference in results when reagents are added in the above order and when lime is added first, then the other three added together at the same time. It is of advantage under certain conditions to add the frother to the ball mill for the emulsification obtained there, but the most economical method for the collector is to add it just ahead of the flotation machines.

Collectors

At the present time sodium and potassium ethyl xanthates are the most widely used selectors or collecting agents. There is undoubtedly, however, a strong chemical attraction between pyrite and the xanthates which makes depression of pyrite difficult when xanthates are used. There are other collectors that exert less effect on the pyrite, notably a reagent called "sodium aerofloat," that has proven in some cases to have a greater action on copper minerals and less attraction for pyrite than the xanthates. This reagent is made by treating absolute ethyl alcohol with phosphorus pentasulphide, then neutralizing the resultant thio acid with a solution of caustic soda. Chemically, it is thought to be sodium diethyldithiophosphate. This reagent is used to some extent also in lead-zinc work and is a modification of "phosphocresylic" acid which was a combined frother and selector, made by treating cresylic acid with phosphorus pentasulphide. The "sodium aerofloat" is a collector only and is a white, crystalline substance, soluble in water, which can be used in conjunction with pine oil, raw cresylic acid or other frothing agent. Used at the rate of .015 pound per ton of ore it has given copper recovery equal to that obtained by .06 to .08 pound of sodium xanthate per ton, and much better rejection of iron than can be gotten with any quantity of xanthate.

FROTHERS

Although pine oil is used as a frother in a large majority of plants, raw cresylic acid has proven a better frother in some cases. With certain ores pine oil has a marked tendency to make a siliceous froth, particularly tending to float colloidal siliceous matter. In such cases, the use of cresylic acid as a frother has resulted in a cleaner froth, and has made marked improvements in the cleaning, settling and filtering of the finished concentrate. The use of coal tar creosotes, containing only a low percentage of tar acids has been almost entirely abandoned, since it was found that 70 to 90 percent of these oils were practically inert in flotation.

CALIFORNIA'S NON-METALLICS

(*Continued from page* 678)

chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically.

POTASH

The principal consumption of potash is as an agricultural fertilizer and in fertilizer mixtures. Other uses for potash salts, are in the manufacture of the best liquid soap, and some higher-grade cake soaps, of some finer grades of glass, and in matches. The chemical requirements include tanning, dyeing, metallurgy, electroplating, photography and medicine.

About 10 percent of our domestic requirements is at present produced in the United States, the largest factor being the yield from the Searles Lake brines in San Bernardino County, this state.

Potash production began commercially in California in 1914 with a small yield from kelp. Considerable time and money have been spent on research work incident to developing deposits of potash-bearing residues and brines in the old lake beds of the desert regions, and production there has been accomplished on a commercial scale at plants on Searles Lake as above indicated. Some is also made annually from saltworks bitterns, from distillery-slops char, and for a time there was some from Portland cement dust.

SALT

Most of the salt produced in California is obtained by evaporating the waters of the Pacific Ocean, plants being located on the shores of San Francisco Bay, Monterey Bay, Long Beach, and San Diego Bay. Additional amounts are derived from lakes and lake beds in the desert regions of the state. The salt production of San Bernardino County is in part derived from deposits of rock salt, which are worked by means of quarrying and steam shovels. Some also is prepared by crystallization from the brines of Searles Lake, which are worked mainly for potash and borax. A small amount of valuable medicinal salts is occasionally obtained in Mono and Tehama Counties by evaporation from Mono Lake and mineral springs, respectively.

Formerly a considerable proportion of the table salt consumed in California was shipped in from eastern points, but at present California salt refineries supply not only our own needs but export a fair tonnage to other markets.

SODA

Sodium compounds to some extent replace potassium compounds in glass and soap making, in photography, in match making, in tanning, and in the manufacture of syanide for extracting gold and silver from their ores.

The production of carbonates and sulphate of sodium in California in recent years has included soda ash and bicarbonate from plants at Owens Lake, Inyo County; trona ("sesqui-carbonate," a double salt of Na_2CO_3 and $NaHCO_3$) from Searles Lake, San Bernardino County; and salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County, and Salton Sea, Imperial County.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, and chemicals, the salt cake in paper making, and the trona for metallurgical purposes.

SUMMARY

In round numbers the present annual value of California mineral groups total in excess of $450,000,000, divided approximately as follows: Fuels, $370,000,000; metals, $20,000,000; structural materials, $55,000,000; industrial materials, $5,000,000; salines, $4,000,000. Of the 58 counties of the state there is not one but what can or does contribuate at least a portion to one or another of these groups. Some counties contribute to all of them.

PROBLEM OF TREATING SOUTH DAKOTA "BLUE ORES"

METALLURGICAL methods which have proved successful in the treatment of the so-called "blue ores," of the Black Hills gold mining district in South Dakota, heretofore not amenable to satisfactory treatment, are described in a report just issued by the United States Bureau of Mines, to whom the problem was submitted by the mine operators of the district. The outstanding feature of the process developed by the Bureau of Mines provides for a maximum cyanide recovery of the precious metals associated with arsenic and antimony ore by a low-temperature short-time roast. The process has also proven successful in the treatment of certain metallurgically difficult ores from the Manhattan, Nev., gold and silver district.

The blue ores of the Black Hills mining district have presented a refractory gold problem for nearly half a century, state Edmund S. Leaver and Jesse A. Woolf, authors of the report, which is published under a cooperative agreement between the Bureau of Mines and the University of Nevada. In the higher central area of the northern Black Hills there is a flat formation of Cambrian limestone and shales supported by underlying quartzite. At the horizon where the ore occurs the original rock appears as dolomitic limestone, now partly replaced by silica carrying gold and a little pyrite. The unoxidized portion of the ore bodies is commonly bluish, which accounts for the local term "blue ore," in contradistinction to the brown or oxidized ore.

A series of breaks or vertical fractures extending into or through the quartzite probably furnished the channels for the mineral-bearing solution to reach the soluble limestones where the mineralization extended laterally for an unknown distance. That is to say, the workings of the mined oxidized ores occur in and adjacent to the fractures; the unoxidized blue ore that appears at the faces of these workings has not been extensively prospected, except in the Commonwealth mine. Several mills were erected which for a number of years treated a considerable tonnage of oxidized ore by a direct cyanide process with the recovery of about 75 percent of the gold. All of these mills were later shut down.

The preliminary work in this investigation was conducted at the Bureau of Mines Rare and Precious Metals Experiment Station, Reno, Nev. On the basis of results at Reno, a demonstration plant of 1 ton daily capacity was installed at the South Dakota State School of Mines at Rapid City.

The findings of the investigation which resulted in the development of a successful process for cyanide extraction of the gold and silver content of these ores, are summarized in Technical Paper 423.

Full details of this investigation are given in Bureau of Mines Technical Paper 423, "Cyanide Extraction of Gold and Silver Associated with Arsenic and Antimony in Ores, with Especial Reference to Those in Nevada and South Dakota," copies of which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 15 cents.

COAL

NEWELL G. ALFORD
Editor

Practical Operating Problems of the Coal Mining Industry

RECENT TENDENCIES *in* COAL-MINE VENTILATION*

By GEORGE S. RICE †

Improved Practices In Mine Ventilation During Recent Years—Research Work Here And Abroad Has Resulted In Better Fan Design And Higher Ventilation Efficiency—Types Of Fans Discussed

MINE-VENTILATION methods have shown a marked improvement during recent years. It was not so many years ago that a mine fan was purchased as a stock piece of machinery, to be of a certain width and diameter and a rated capacity of so many thousand cubic feet per minute, without reference to the pressure necessary to send this current around the mine. A little later, when the mining company found it advisable to specify what minimum air pressure would be required for a minimum volume, the specifications were usually vague as to where the pressure was to be determined, and little attempt was made to obtain a fan to fit the mine. Rather it was a haphazard selection. The rapid increase in the capacity production of mines, the larger number of miners required, and the increasing areas of coal mines demanded that attention be paid to increased ventilation, which led to more precise specifications being furnished to fan manufacturers who independently had been making improvements in fan construction.

A committee was appointed by the British Institution of Mining Engineers to look into the whole question of mine ventilation. This committee recommended new standards and a new nomenclature concerning standards, therefore discarding the long-accepted "equivalent orifice" of Murgue. The committee also began investigating the ventilating systems in mines and found that unnecessary losses in power were incurred.

The American Institute of Mining and Metallurgical Engineers also organized a Mine Ventilation Committee. Meanwhile, laboratories in various universities both in the United States and England began tests to determine frictional resistances to the flow of air in various kinds of ducts and the effects of curves. Notable work has been done in the United States by the mining departments of Illinois and California universities, and in Great Britain by the mining departments of Birmingham, Sheffield, and Edinburgh Universities.

George S. Rice

The United States Bureau of Mines began intensive investigations of ventilation, first in metal mines, as in Montana and Michigan, and later in coal mines. In 1920 one of the most important investigations ever made in underground ventilation was conducted by the Bureau of Mines and the University of Illinois for the Holland Vehicular Tunnels between New York and New Jersey, which have today the largest ventilation capacity of any one plant, 7,500,000 cu. ft. per minute, produced by 80 fans.

The high velocities necessitated in the air conduits of the twin tunnels, and the question of the shape of the passageways and outlets and inlets, required the most careful testing and studies, which were conducted in small apparatus, then in a full-size model of an air conduit at Urbana, and finally in an experimental facsimile tunnel of about one-third the sectional size in the Experimental Mine at Bruceton, Pa.

Following this fundamental work, carefully devised studies were conducted by Messrs. McElroy and Greenwald in the Experimental Mine, and similar studies were made in commercial coal mines of Illinois by Professor A. C. Callen, of the University of Illinois. These tests related to loss of power by bends, obstacles, and surfaces of the passageway, including irregular surfaces.

These various studies, together with those in metal-mine shafts on the frictional effects of different kinds of linings, have greatly interested mining men and have led to better arrangements in the selection of fans and in fan design. Some of the larger mining companies now employ ventilating engineers to great advantage.

In former years fan manufacturers paid little attention to research. Prob-

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† Chief Mining Engineer, U. S. Bureau of Mines, and until recently Chairman of the Ventilation Committee of the American Institute of Mining and Metallurgical Engineers.

ably more scientific investigation was done in France than in any other country until the Sirocco fan was developed in England. This was the first small-diameter, high-speed fan which gave attention to the shape of the blades and the movements of the air through the fan, as had already been done in the design of water turbines. Some years ago fan manufacturers in every country began intensive research, and now the old, large-diameter, cumbersome mine fan is obsolete.

It was formerly the practice to drive fans by steam engines, and this procedure was followed in many cases even after electricity began to be used more and more extensively. For one reason, the lack of flexibility of the A. C. motor-driven fans and the higher cost of the D. C. variable speed motors made the steam drive seem advantageous, especially where there was only one source of electric power. However, with the development of the superpower station and the cheapening of electric power, electrically driven A. C. fans have become almost universal in the United States. The question of the change in the speed of the fans seems less important today than formerly. It is considered to be the best practice, from the safety standpoint, that the main fan be kept steadily at the same speed 24 hours of the day. If circumstances increase the mine resistances, it will then be necessary either to cut out this increased resistance by improving the air courses or else to increase the speed of the fan by changing the diameter ratio of the drive pulley of the motor and the drive pulley of the fan-shaft, which may also require a larger motor.

Detailed surveys by specialists of the ventilating systems in various mines have brought attention to the tremendous waste of power for ventilation in the average mine. Fifteen years ago the Bureau of Mines found (in certain mines of a large group in Illinois) that, due to leakage, chiefly in the stoppings but also in the doors and elsewhere, only 10 percent of the air leaving the fan reached the face. In the best practice only 50 percent reached the face. That condition has undoubtedly improved in every state, but recent surveys have shown there are still large unnecessary power losses which are invisible and usually unrecorded but nevertheless exist.

One example came to my attention some months ago, where it was found in a certain mine that one-third of the air which left the fan leaked through a partition in the air shaft. The management had been considering a larger fan, but that was manifestly quite unnecessary if the partition was made tight, or, what would be far better practice, if a large air shaft with no partitions was sunk. If you will stop to consider, what seems to be a small loss at any one time in the power in a ventilating current is nevertheless a loss which is going on every minute in the hour, every hour in the day, and every day in the year, and often involves losses of thousands of dollars per annum.

Smooth lining in the shafts, streamline buntons (which latter have recently been tested and found advantageous in Germany), and long sweeping curves where the fan's drift connects with the air shaft at the bottom of the shaft make for extensive saving of power. If circumstances render it impossible to give long sweeping curves, deflecting vanes will greatly reduce the eddying which so consumes power, as found during tests in connection with the Holland Tunnels.

The loss of power through leakage at stoppings and overcasts is wholly avoidable. Some loss at single doors is unavoidable. On the other hand, the number of doors in a set should be increased, but the number of sets should be reduced to a minimum by proper splitting of the air current and use of overcasts. However, by far the greatest loss of ventilating power is in forcing air through small airways or those in which the roof has been allowed to fall. If these airways are the returns, too often they are neglected and blocked by falls. In the long run, it is a saving to retain tracks in air courses, keep the roof timbered, and clear up falls.

Blockage of the airways by the trips of cars is another problem. The increasing size of cars has made this a more and more serious question, that can be met by having more airways. Similarly, cages often block the air current in hoisting shafts, whether the intake or the return. Today it is generally accepted by careful mining men that it is the best although by no means the universal practice to have the hoisting shaft and the haulageways on the intake air.

In a few instances where there are three or more shafts, the hoisting shaft is made a neutral shaft. If this plan is not followed, the hoisting shaft should be of such size, preferably round, that the cages in hoisting make a minimum obstruction to the flow of air.

Finally we come to the question of fans. Fans have been greatly improved. Perhaps during the last year or two the development has been in improving the housing of the fan, rather than within the fan itself. Practically all main fans are centrifugal fans, which may be divided into impulse fans, such as the high-speed multiblade fans of the bucket reaction type and true centrifugal fans with radial or backward curving blades. The former type is the more efficient within a more limited range for specific pressures. If over a long period of years the mine will have practically constant characteristics the multiblade impulse fan might be indicated as best.

Where, however, the range of use is considerable, both the velocity and pressure changing, or where there are fans operating in parallel, a backward-curving blade would seem best suited. This is the kind which has been adopted for vehicular tunnel ventilation.

In a great many of the smaller drift mines in the United States the so-called disc fan has been used a great deal because of the small cost and convenience in erection. This fan as usually installed has very definite limitations in producing pressure and ordinarily is not applicable where a mine pressure of over 1 inch of water gauge is found; 2 inches of water gauge would be the extreme. Where it has been employed as an inside booster fan, it has been found to present serious dangers from markedly recirculating the return air and gases.

Within a few years a new type of fan has been evolved through the development of airplane propellers. The airplane propeller type was first tried at the Northfield Colliery, Napal, and is called the Steart air-screw fan. It has a number of propellers arranged in series on a single shaft, so that the propellers build up the pressure-difference stage by stage after the manner of a turbo-compressor. In the Northfield Colliery Steart used six metal propellers and obtained a mechanical efficiency up to 70 percent, the volume passing being 180,000 cu. ft. per minute at a 3.4-inch water gauge.* Recently an air-screw fan has been installed at the Grange Colliery, near Sheffield, England.

Some years ago, at extensive collieries, the practice of placing one or more of the main fans underground at supplementary air shafts was introduced, but mine explosions and fires in several of the mines where this was tried resulted in wreckage of the fan, showing that this practice is not a good one.

Booster fans have been used to some extent, but in a number of instances these are said to have caused explosions and in others have been wrecked by explosions, so that unless the conditions are very exceptional their use is not considered good practice. The exceptions

The subject of this article is one upon which there are many opinions. The views presented are those advocated by the author of the United States Bureau of Mines, but are not necessarily subscribed to by* THE MINING CONGRESS JOURNAL.—*The Editors.

* See "Some Notes on the Application of Air Screws to Mine Ventilation," Journal, Chemical Met. and Min. Soc., S. Africa, XXIV, 1923.

where special precautions should be taken are in mining under the sea or under a high mountain range, where it would be practically impossible to put down another shaft. Then a booster fan is considered allowable if every effort has already been made to improve conditions underground by providing ample airways and keeping them cleaned up. If under these conditions the air pressure necessary at the main fan is over 6 in. of water gauge, at which pressure it is difficult to operate doors, a booster fan is considered allowable.

Perhaps the use of underground blower fans in coal mines has led to more controversy than any one technical subject during the last couple of years. That blower fans in metal mines are necessary under the conditions is universally conceded, but in coal mines, which in the opinion of many are potentially gassy, blower fans present a certain hazard. The increasing mechanization of coal mines and the concentration of work in a limited area have unquestionably increased the difficulties of local ventilation. Blower fans with canvas tubing had already been extensively used in metal mines and found very advantageous, so it was natural that they would be tried in coal mines. Their use in gassy and slightly gassy coal mines has led directly or indirectly to at least six explosion disasters in the last few years. Whether these explosions, due to igniting gas which in turn usually ignited coal dust, can be blamed upon bad equipment, bad installations, or improper methods of application will not be discussed in this article.

The United States Bureau of Mines, in its Mine Safety Decision No. 4, says:

"In the interest of safety, the Bureau of Mines, Department of Commerce, recommends that auxiliary fans or blowers should not be used in coal mines as a substitute for methods of regular and continuous coursing of the air through every face of the mine."

The arguments for blower or auxiliary fans with tubing are:

(1) They insure forcing fresh air into a heading or room and in that way prevent the danger of accumulation of methane at the face.

(2) They insure giving a good supply of fresh air to every face worker.

(3) They use a small amount of electric power and avoid the air friction losses in deflecting a main ventilating current or a split of same, into a heading up to the face by line brattices.

(4) They lessen the number of crosscuts or breakthroughs, and on the other hand avoid the extensive use of brattice cloth, which tends to leak and causes loss of power from friction and leakage of the air.

(5) Blower fans with canvas tubing are exceedingly easy to move.

The objections may be summed up thus:

(1) They cause recirculation of gases given off at the face.

(2) As ordinarily used, where there are a series of blowers in parallel unconnected headings or rooms, there is an accumulation of gas from one to the other; the return of one becomes the intake of another.

(3) As generally used, blowers are shut down except during the working shifts, so that gas which may accumulate at other times has to be moved out before the fan is started; or if started, it is liable to ignite gas if electrically driven. In any case mining men regard "a body" of fire damp as a serious danger.

(4) Practically all blower fans, as used in the American mines, are electrically driven, as contrasted with compressed-air driven fans in Europe. The electric motor and the wiring from the permanent power wire to the fan motor of necessity present an electrical hazard even if the motor is made explosion proof.

Conclusion

Methods of coal-mine ventilation have improved greatly in recent years. It can not be said that this statement covers ventilation practice in all coal mines but rather in the best operated, partly due to increased knowledge of the subject and to better equipment. This situation has been forced by an increase in the size and capacity of mines. The greater ventilation requirements are reflected in amount of power required. Professor A. C. Callen found that an average power requirement of 40 Illinois mines represented 22.45 percent of all the power consumed at these mines. Professor Henry Briggs, of Edinburgh, found about this same percentage in a group of British mines; he also pointed out that five to ten times greater weight of air was moved per 24 hours than weight of coal hoisted.

As indicating the greater ventilation requirements of the present, we have today in this country half a dozen coal mines which are producing three to six million cubic feet of pure methane in 24 hours, and in most of these mines the return air in the main splits is kept under 1 percent. In one case it was 1½ per cent, but improvement will probably be made. Then, years ago the handling of such an amount of gas would not have been considered possible. It can be only safely done by daily analyses of all the returns.

It is safe to say that improvements will continue in all lines of mine ventilation. In fact, improvements will have to come as the mines get deeper to dispose of the greater volumes of methane given off and also to keep up with the advances which are being made in mine mechanization and the concentration of large capacity in small areas, involving as they do the liberation of a large amount of methane in a small area.

COAL-MINE FATALITIES

ACCIDENTS at all coal mines in the United States during the month of July resulted in the death of 123 men, according to reports of state mine inspectors to the Bureau of Mines. Of this number, 99 fatalities occurred at bituminous mines, the remaining 24 resulting from accidents which occurred in the anthracite mines of Pennsylvania. The total production of coal during the month was 40,671,000 tons, of which 36,230,000 tons was bituminous, and 4,441,000 tons was anthracite. Based on these figures the death rate, for the industry as a whole, per million tons of coal produced, was 3.02; that for bituminous was 2.73; and for anthracite it was 5.40. The death rates for July, a year ago, were 3.24 for bituminous mines, based on 109 deaths and 33,637,000 tons production; 5.97 for anthracite, based on 30 fatalities and 5,028,000 tons; and 3.59 for all coal mined, based on 139 fatalities and 38,665,000 tons of coal mined. Thus the fatality rates for July, 1928, for both bituminous and anthracite, show a reduction from July of last year.

Reports made to the Bureau of Mines for the first seven months of 1928 show 1,258 fatalities caused by accidents at all coal mines. The production of coal for this period was 312,063,000 tons, showing a death rate of 4.03 per million tons as against 3.83 for the same seven months of 1927, based on 1,364 deaths and 356,191,000 tons of coal.

HERRINGBONE GEAR DRIVES *on* MINE FANS

By W. H. LESSER *

Natural Adverse Conditions Under Which Mining Machinery Operates, Makes Selection Of Proper Speed Reducing Units A Problem For Best Thought Of Those Responsible For Successful Operation Of Equipment—Results Obtained By Applying Herringbone Gear Drives To Mine Fan Outlined

A MORE general use of electrical power in the mining industry makes necessary the use of electric motors, the speed of which is, in most cases, higher than that of the equipment to be driven. Motor installations of this class include also a decision as to the type of mechanism which is required to make the desired speed reduction. Some few motor applications may be made without reducing the speed; two prominent examples in this class being centrifugal pumps and large air compressors. Keeping in view the natural adverse conditions under which mining machinery operate and the grade of supervision available, the selection of the proper speed-reducing unit should receive the best thought and consideration of the engineers responsible for the successful operation of the equipment.

The tendency, during recent years, is to use a speed-reducing unit of a type in which the ratio of speed reduction is positive. In them, there is no slippage as exists in belt drives, and the danger of an interruption in the service due to the belt jumping off the pulleys is entirely avoided. Three types of positive reducers are being increasingly used in installations of mining machinery: the herringbone gear drive, gear speed reducers, and worm gear reducers. This article will deal with the first mentioned type of reducing unit as particularly applied to mine fans.

Unquestionably the art of gear cutting has been greatly improved in recent years, and much credit, therefore, is due to the gear manufacturers for the highly efficient gears now available. The perfection attained in gear cutting is due to a strict adherence to the scientific design of the teeth and to the development of accurate gear cutting machinery. Properly designed teeth result in silent running gears for long periods of service. A rigid alignment of shafts, so necessary for efficient gears, is now being maintained by roller or ball bearings. Durability and low maintenance costs are obtained by the use of alloy steel, and the heat treating of ordinary carbon steels.

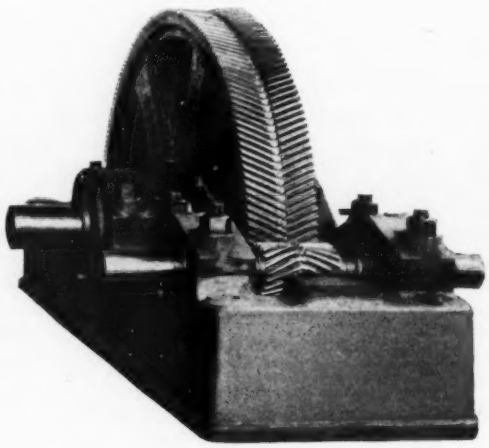


Figure 1

In the application of herringbone gear drives to motor driven mine fans, one must be assured that they are durable, and that continuous operation is possible. Such requirements are paramount in mine fan installations, since the lives of many men depend upon a continuous and unfailing supply of fresh air. They should be designed with the highest possible efficiency, as every slight increase in efficiency means a saving in power costs. The continuous duty of mine fans as compared with the intermittent duty of other mining equipment makes it particularly important to use a reducing unit in which the power losses have been reduced to a minimum. A low maintenance cost should be attained, and little supervision should be necessary; the latter requirement applies especially to installations situated in a remote section of the property where it is difficult to get good supervision.

In 1921, when Madeira Hill and Company completely electrified their Greenough Colliery, it was necessary to put motors on two mine fans which were driven by belted steam engines. Since the mine was gaseous, continuous operation was given first consideration in the selection of the speed reducing unit. We wanted a unit that was durable, efficient, and one from which we could expect a low maintenance cost.

After considering the above phases of the question, it was decided to install a herringbone gear drive as shown in *Figure 1;* its installation in the fan house is shown in *Figure 2.* This drive transmits 50 hp. with a pinion speed of 690 r. p. m. and a driven speed of 68 r. p. m. The face of the gears is 6 in. wide, and the teeth have a diametral pitch of five. Roller bearings are used,

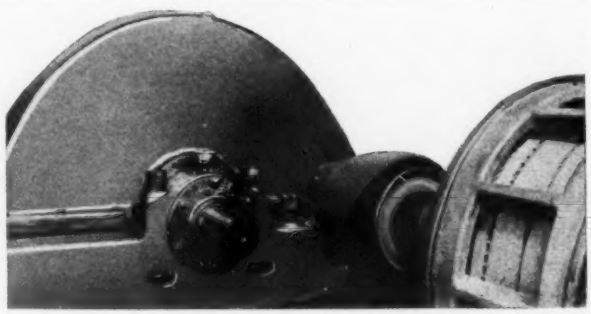


Figure 2

* Mechanical Superintendent, Madeira Hill & Co., Frackville, Pa.

Figure 3

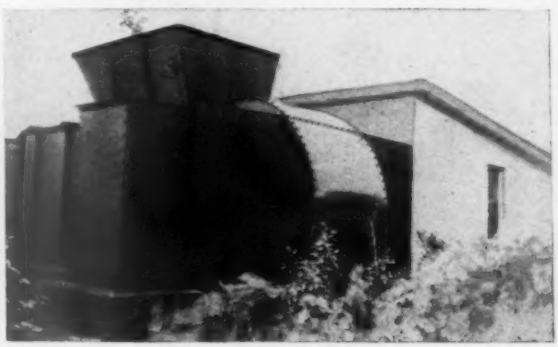


Figure 4

which facilitate their quick removal and which give a good shaft alignment. The gears are enclosed in a gear case, thereby providing a reservoir for the lubricant and making it possible to exclude the dust and grit from the wearing surfaces. An efficiency of 98 percent was guaranteed by the manufacturer. Due to the fan being old and its bearings not in the best of condition, flexible couplings were placed on both the driving and the driven shafts. The driven gear was made from annealed cast steel 0.30 to 0.40 carbon with a Brinnell hardness of 150, and the driving pinion was forged from chrome nickel heat-treated steel with a Brinnell test of 250. This combination of metals was selected, as the manufacturer's experience indicated that long and satisfactory service could be obtained from it.

An exterior view of the fan is shown in *Figure 3;* it is 21 ft. in diameter and 7 ft. wide. You will note its fire-proof construction. No attendant is required, as a full automatic control is used for starting and stopping the motor.

In 1922 a reversible mine fan was purchased for Madeira Hill & Company's Natalie Colliery, and again we decided to use the herringbone gear drive as the reducing unit. An exterior view of the fan is shown in *Figure 4;* it is 6 ft. in diameter and 4 ft. wide. It is located 2 miles from the nearest attendant, making necessary the use of a fully automatic control panel.

Figure 5 shows the drive as installed. It transmits 50 hp., motor speed 585 r. p. m., and fan speed 255 r. p. m. The gears are 4 in. wide, and the teeth have a diametral pitch of 5. All the other details are similar to those of the drive at the Greenough Colliery, just above described.

Such in brief is a description of the gear drives as we have applied them; their maintenance costs are shown in *Figure 6.*

FIGURE 6

YEARLY MAINTENANCE COST OF HERRINGBONE GEAR DRIVES ON MINE FANS

	Name of Fan		
	Greenough No. 2	Greenough No. 1	Natalie No. 1
Horsepower	50	50	50
Ratio of reduction	6.0 to 1	10.1 to 1	2.29 to 1
Cost of lubrication	$45.24	$45.24	$50.00
Cost of repair parts	4.72	4.72	0.00
Total material parts	$49.96	$49.96	$50.00
Cost of labor for inspection	$3.00	$3.00	$3.00
Cost of labor for repairs	1.00	1.00	0.00
Total labor cost	$4.00	$4.00	$3.00
Total annual cost of labor and material	$53.96	$53.96	$53.00
Date placed in service	1922	1922	1923

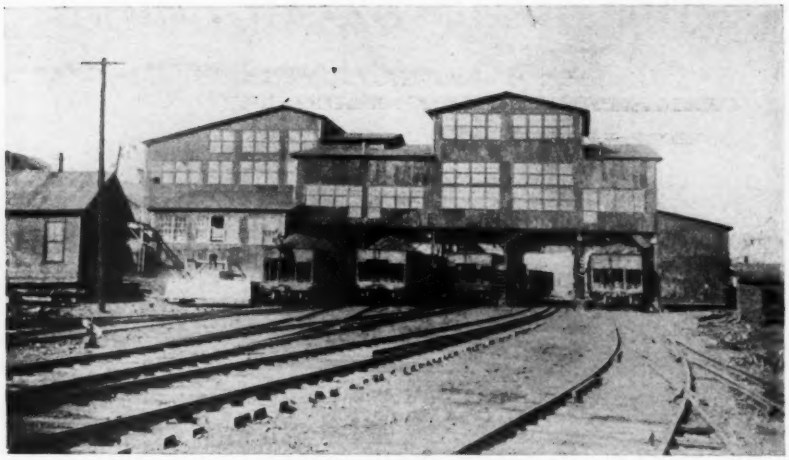
You will note that no repair parts were purchased for the Natalie fan during a period of five years. Those parts purchased for the Greenough fans during a six-year period consisted of a set of coupling bolts and rubber buffers for each of the flexible couplings on the motor shafts. They cost $28.32 per set.

After six years of service from these drives we are in a position to conclude whether good judgement was used in their selection, if they are reliable, and if their maintenance cost is reasonable.

A decision to use drives of this type to operate mine fans supplying air to gaseous mines may be made without any doubt in one's mind as to the future operating results. Reliability and continuous operation, such important elements in installations of this character, are possible to obtain. During the six years that these drives have been in operation, not once have they been responsible for an interruption in the fan service. A maintenance and repair cost as reported in *Figure 6* is low, and should please the most exacting mine manager. A recent inspection of teeth on pinions and gear wheels shows very little wear.

In summing up our experience with herringbone gear drives on mine fans, there are several outstanding features worthy of mention. The simplicity of the drive impresses one immediately, if it is compared with other types of speed reducers. No great space is required for its installation; hence the initial investment cost in a fan house is reduced. Their rugged design and the lack of many parts make it possible to operate them with the minimum of attendance. And finally, they have demonstrated their entire reliability in such an important installation as a mine fan.

Figure 5



Mount Union Tipple

The SAND FLOTATION PROCESS *as* APPLIED *to the* WASHING *of* COAL

By T. M. CHANCE *

Sand Flotation Method Of Cleaning Coal Commercially Introduced In 1921 — Plants Installed Now Have Capacity Of 10,000,000 Tons Per Year —Costs And Operating Results In Anthracite And Bituminous Coal Cleaning

THE sand flotation process is a commercial application of the float-and-sink method of testing coals, in which a solution of density sufficient to float the coal, but permitting the refuse to sink, is used. It has been developed in the belief that it would overcome some of the difficulties inherent in the older methods of coal preparation.

High-density solutions of solids in liquid are so expensive and so difficult to recover from the separated products that attempts to commercially use them have not been successful. In sand flotation the heavy solution is replaced by a high-density mechanical mixture of a comminuted solid, such as sand or fine refuse, and water, this mixture being termed a "fluid mass." It is maintained in a highly mobile condition by hydraulic agitation, and is thus caused to assume the general physical characteristics of a liquid of high density. The densities used depend upon the coal to be cleaned, those used in anthracite preparation ranging from 1.60 to above 1.75.

The cylindro-conical type of separator has been generally used in commercial plants, and provides an effective method for withdrawing the refuse from the high-density fluid mass. In this type of apparatus the lower part of the fluid mass is supported on an upwardly rising column of the hydraulic water required for agitation. The conduit containing this column is termed the "classifier column," and the agitation water rises therethrough at a velocity permitting the refuse to fall, but sustaining most of the sand.

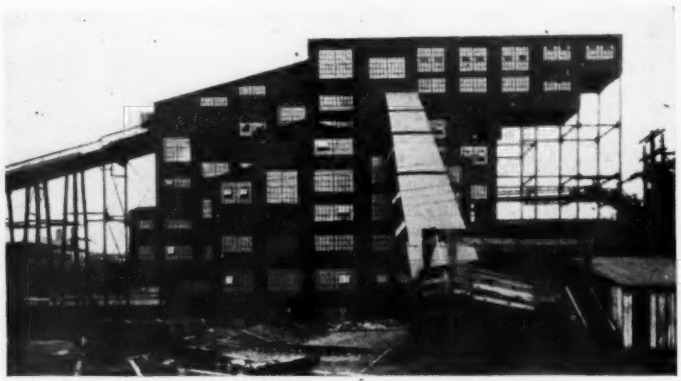
The coal is discharged by causing some of the fluid mass to overflow at the top and the refuse is withdrawn through a water seal by interlocked slide valves at the base of the classifier column. Conveyors may be used for these purposes, although the tonnages handled would require equipment of large capacity and would cause increased breakage of the coal.

A mechanical agitator is used in machines operating at the higher densities which efficiently diffuses throughout the cone small quantities of agitation water required for these densities. For the production of low densities additional agitation water may be introduced through the walls of the cone.

When properly operated the sand flotation process can practically duplicate the results of float-and-sink tests, as it similarly separates the coal by a method based on immersion in a high-density medium. Pieces of any desired size, down to the smallest particle that can be separated from the sand, may be treated. Units may be constructed to treat any size of lump coal which it is economically feasible to clean.

In such a flotational process size, shape and frictional characteristics need play no part in the separation, as the only property necessarily used is that of specific gravity. The ash content curve generally follows closely the specific gravity curve for any given coal; therefore such a specific gravity separation affords close control of the ash in the washed coal and refuse.

The operating results of the last six years have indicated the following advantages in the use of sand flotation: Shipment



The Von Storch Breaker

* H. M. Chance & Co., Consulting Mining Engineers, Drexel Building, Philadelphia, Pa.

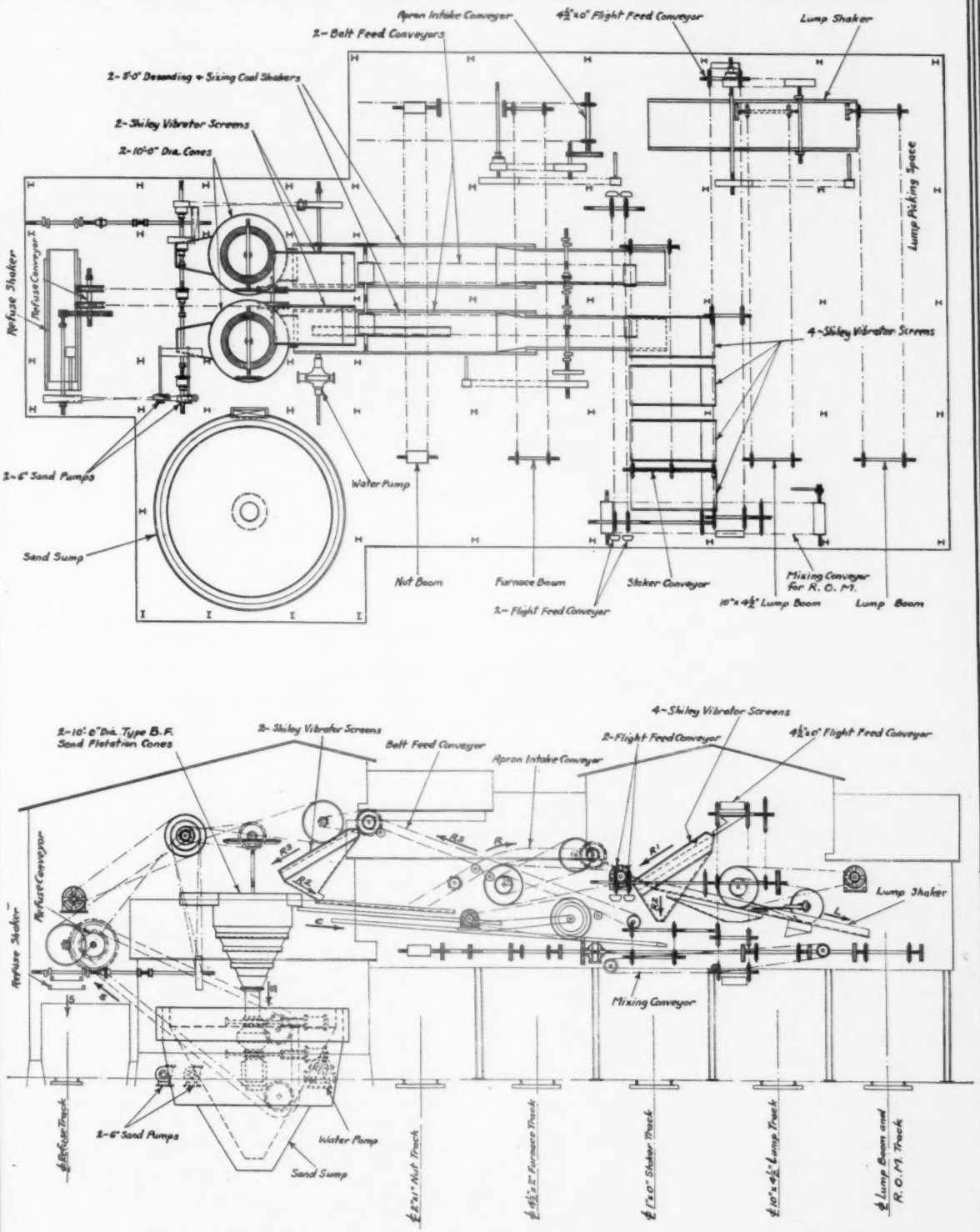
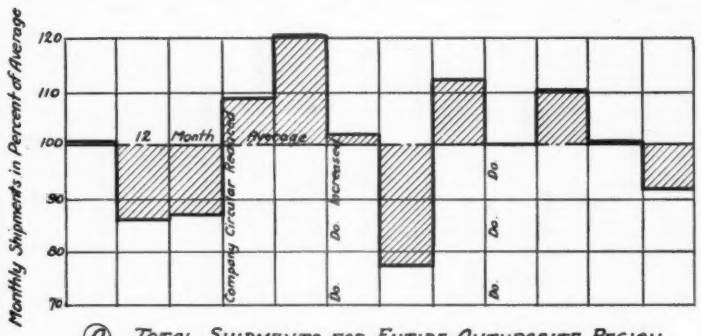


FIG. I~ MOUNT UNION SAND FLOTATION TIPPLE
CLEANING BITUMINOUS COAL.

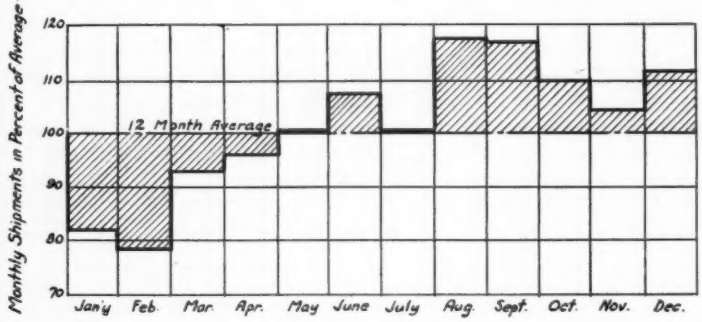
0 5 10 15 20 25
Scale in Feet

LEGEND

R.O.M. Raw Coal	R
4½"x0" do. do.	R¹
⅜"x0" do. do.	R²
4½"x⅜" do. do.	R³
Clean Coal	C
Lump Coal	L
Refuse	S



Ⓐ TOTAL SHIPMENTS FOR ENTIRE ANTHRACITE REGION
ALL METHODS OF PREPARATION



Ⓑ TOTAL OF NINE SAND FLOTATION ANTHRACITE COLLIERIES
INCLUDING TWO BANK WASHERIES

PROPORTION OF MONTHLY SHIPMENTS
TO
AVERAGE DURING 12 MONTH PERIOD
January 1st, 1927 to January 1st, 1928

FIGURE II.

of pure coal; minimum breakage; minimum attendance; low first cost of plant; intermittent feed is permissible; radical changes in quantity of feed are permissible; maximum operating time of plant.

To secure these results the system must be properly operated. Thus, the fine coal either must be removed before washing, or later removed from the sand circulating system, otherwise a fluid mass of fine coal of low density will replace the sand fluid mass. Again, if coal and slate are fed into the cone more rapidly than they can be removed, it is obvious that a proper separation cannot be made. However, where ordinary operating supervision is exercised, the advantages outlined above readily can be realized.

* Mining Congress Journal, March and June, 1927; July, 1928.

Commercial Development

Sand flotation was commercially introduced during the autumn of 1921. Since then less than six operating years have elapsed (there having been three general strikes), yet it is estimated that over $4,000,000 has been expended in sand flotation plant construction, the units installed having a total cleaning capacity in excess of 10,000,000 tons per year.

During this period the process has been introduced at 26 anthracite collieries and 1 bituminous operation. At the present time new installations, having an aggregate daily cleaning capacity of 13,000 tons, are being planned and the construction of one such plant by the Jeddo-Highland Coal Company—long recognized as a leader in the preparation of premium anthracite—is already under way.

The general details of typical sand flotation anthracite plants, together with the Mount Union bituminous installation, have been given in previous issues of the JOURNAL.* The layout of the Mount Union plant is well shown in the drawing (Figure I), which illustrates the general flow of the materials in a typical sand flotation plant.

Sand flotation preparation plants in general present marked economies in plant area, building volume, building height, shafting and other machinery, electrical equipment, operating labor.

These advantages have been recognized in reducing the fire risk, as shown by the following base rates established by the underwriters covering fire insurance on anthracite breakers:

	Non-Combustible Throughout	Non-Combustible Plank Flooring	Frame or other Combustible
Standard Breaker..	$0.50	$1.40	$2.00
Sand Flotation Breaker Crushing Plant Integral..	.25	1.30	1.85
Sand Flotation Breaker Crushing Plant Separate..	.25	1.25	1.75

Economic Factors and Operating Results

1. Anthracite

Production

Sand flotation anthracite is now so standard a commodity that little need be said on this subject. This grade of coal is always in such demand that its production permits steady breaker operation. Thus, during the year 1927, which was not a good anthracite year, nine anthracite sand flotation plants averaged 289 working days, ranging from 274 up to 302 days.

Further, during that year a steady increase in output was achieved by many of the anthracite collieries using this process. This is well shown in the charts of Figure II. These diagrams graphically show (A) monthly shipments for the entire anthracite region plotted against the average for the 12 months, together with (B) monthly shipments of seven typical sand flotation breakers shipping fresh-mined coal and two sand flotation salvage plants recovering coal from old breaker refuse banks.

An inspection of curve A illustrates the seasonal demand for the average grades of anthracite, with purchases stimulated during April and May by reduction of the "circular" price and a falling off in demand to a minimum of about 78 percent in July. Curve A does not show any definite trend of increase or decrease of production over the entire year.

The sand flotation curve B, on the other hand, illustrates a definite increase in de-

mand during the entire 12-month period, with a small increase during the April-May period, and a negligible falling off in July. Most sand flotation anthracite is in such demand that there is little necessity for stimulating purchase by marked price reductions during the summer months.

Increase in Operating Time

Increased operating time is of paramount importance to the industry. This is due to the high cost of idle time at an anthracite colliery. Such idle time cost during normal operating periods is higher than that which occurs during complete suspensions, because the working places must be daily maintained in condition for the extraction of coal and many of the company hands continuously employed.

It has been estimated that such idle-time cost will run from $0.70 to $1.25 per ton of breaker capacity; hence at a colliery having a normal production capacity of 1,500 tons per day, each idle day will cost about $1,500. If such a colliery can operate 290 days in place of the normal 260 (and in recent years such normal figures have rarely been obtained), a direct saving of $45,000 per year will ensue.

In past years the total cost of storing coal, including the losses in degradation and the actual operating cost of the storage plants, was less than the cost of idle time, and therefore many breakers were kept in operation when there was little or no demand for their product. At present such practice is not always permissible, for in many cases the total cost of storage is greater than the cost of idle time, so this relief is not always available. The production of a grade of coal that will diminish both idle time and storage cost is therefore of very real interest to the anthracite operator.

Condemned Coal

Anthracite coal is inspected at the colliery before shipment, and that which does not meet the standard requirements for slate, bone, sizing and appearance is condemned and reprepared in the breaker. At the present time such condemnation is a serious factor, because the total cost of rehandling, including operating costs and losses in repreparation, runs from $0.60 to $1 per ton.

During the past year the higher standard of preparation required of the ordinary type of breaker has resulted in serious losses, largely due to the increase in condemned coal. Such excessive condemnation has not been experienced at the average sand flotation colliery, inasmuch as the standard normally produced by such collieries is higher than that usually required in the trade. Thus, in a test recently carried out at a sand flotation colliery on coal normally prepared in a breaker of the older type, the entire tonnage tested was passed without condemnation (the egg and stove coal produced averaging less than 6/10 of 1 percent of slate), notwithstanding the fact that condemnation at the breaker in which this coal normally is prepared was excessive and required large overtime operation of the breaker for repreparation of the condemned coal.

Coal Lost to Refuse Banks

Present anthracite standards are only secured at many breakers of the older type at the sacrifice of large losses of coal and salable bone to the refuse banks, over 15 percent of good coal and bone being frequently lost. There have been, however, no commensurate increase in losses to the refuse bank at sand flotation collieries under present conditions, the figures given in a previous paper * being still attained in general practice, as shown by the following averages of refuse bank tests at one sand flotation breaker, made by the lessor company owning the land, over the four-month period, August to November, 1927:

	Percent Coal	Percent Bone	Percent Coal & bone	Percent Refuse
Egg	0.81	1.87	2.68	97.32
Stove	0.94	1.56	2.50	97.50
Nut	....	....	2.50	97.50
Pea	....	....	2.50	97.50

Below pea not reported, classified O. K. by lessor.

In the recent foreign coal test above referred to, the efficiency of recovery for the sand flotation breaker as a whole was 96.5 percent, there being 3.5 percent loss of free coal larger than 1/16-in. silt in the entire crushing, screening and separating process. This 3.5 percent loss is the sum of the total coal lost in the refuse and the total silt (passing 1/16-in. mesh) produced by breakage in the rolls, chutes, screens, etc. These figures were secured from careful tests on the feed, shipped coal and breaker refuse, allowance being made for the slate and bone freed in the breaker by passage through the rolls, etc. This total of 3.5 percent combined silt loss and breaker refuse coal loss is lower than that which would normally be expected from the production of silt alone and is a fair measure both of the low degradation and the high recovery resulting from the use of sand flotation.

2. Bituminous

Production

Experience with the Mount Union bituminous plant has been similar to that of anthracite operations using sand flotation. It has been found possible to enter and hold markets that were difficult to retain when the coal above 1-in. was hand-picked and the 1-in. x 0 slack shipped raw.

While production was naturally curtailed during the recent general suspension, the plant was continuously operated at high capacity prior to that time, and has developed a shipping capacity well in excess of 4,000 tons in 8 hours.

During the entire period of operation of this unit, dating from October 1, 1925, considerably over a million tons of coal have gone to market without the production of a single car of condemned coal.

Sludge and Moisture in Clean Coal

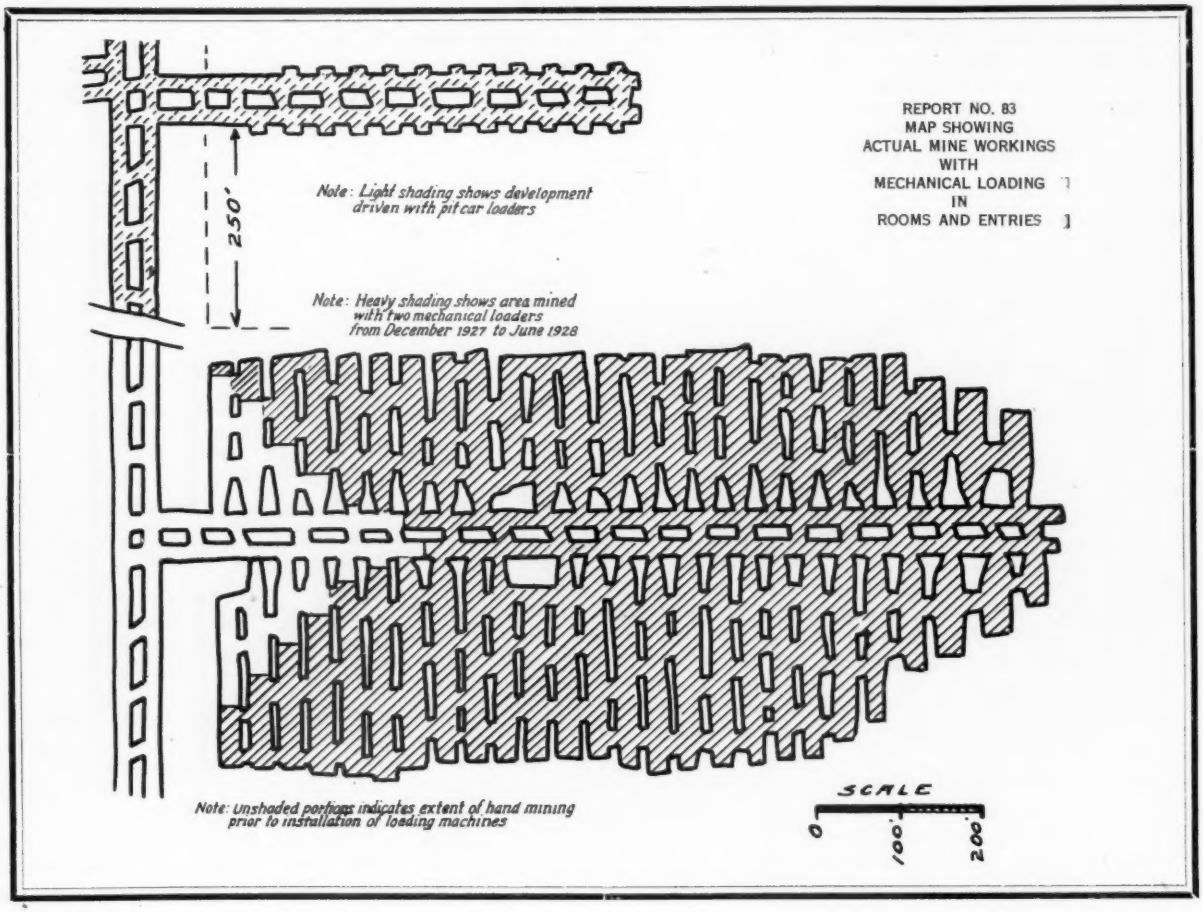
In many cases, the fine coal passing a 3/16-in.-hole screen is insufficient in quantity to require washing, if the plus 3/16-in. is properly cleaned to an ash content approaching the inherent ash of the pure coal. Such by-passing of the raw fines at once eliminates both sludge and the moisture problem, as the mixed drained washed coal and raw fines should run between 4 and 6 percent moisture. Thus, at the Mount Union plant, which contains no special drying or dewatering equipment, the shipped run-of-mine coal (of which the raw ⅜ by 0-in. comprises 18 percent of the product) averages about 3.4 percent moisture and the 1-in. by 0 slack (of which 66 percent is washed 1-in. by ⅜-in.) averages about 5.0 percent moisture. Similar results have been attained at Mount Union when washing down to ¼-in. and in a test at that plant on 227 tons of 2¾-in. by 0 West Virginia high volatile slack, which was washed to ¼-in., the moisture analyses were as follows:

	Moisture*	Ash
2¾" x 1" raw coal	2.58	6.527
1" x ¼"	3.02	8.553
¼" x 0"	7.01†	8.713
2¾" x 0" raw coal	3.59	7.751
2¾" x 1" washed coal	3.43	4.258
1" x ¼" washed coal	5.72	4.261
¼" x 0" raw coal	7.01†	8.713
2¾" x 0" shipped coal	5.25	5.363
2¾" x ¼" refuse	5.160	50.483

*Washed and shipped coal samples taken at loading chutes, hence before any drainage in railroad cars occurred.
†Note high moisture in raw fine coal.

Of course, there are cases where an excessive quantity of very dirty fine coal may require cleaning below 3/16-in., but even such cases frequently can be handled at a larger size than would at first sight appear possible if the coarser sizes are cleaned at low specific gravity and a greater amount of coarse refuse and high ash coal removed. It is often found that the shipped fine coal is much increased both as to refuse content and in total quantity by degradation in screening, etc., and that sam- (*Continued on page* 732)

* Mining Congress Journal of March, 1927.


REPORT NO. 83
MAP SHOWING
ACTUAL MINE WORKINGS
WITH
MECHANICAL LOADING
IN
ROOMS AND ENTRIES
250'
Note: Light shading shows development driven with pit car loaders
Note: Heavy shading shows area mined with two mechanical loaders from December 1927 to June 1928
Note: Unshaded portions indicates extent of hand mining prior to installation of loading machines
SCALE
0
100'
200'

MECHANIZATION REPORT NO. 83

By G. B. SOUTHWARD

Room-and-Pillar Mining With Mechanical Loaders in the Entry Advancement and Room Work

REPORT No. 83 describes a mechanical loading operation in a seam 6½ ft. high and is in a mine which is now 100 percent mechanized. This mine was operated for a number of years with hand loading entirely until three pit-car loaders were installed about three years ago. These were used to some extent for room work, but were later confined to entry development. In December, 1927, two mechanical loaders were put in operation and were worked in a panel separated from the rest of the mine where hand loading was still used. The mechanical operation in comparison with the hand mining showed a decided advantage and economy over the hand work and in June, 1928, three additional loaders were installed and all hand mining was discontinued.

The first operation of the mechanical loaders was in a panel which had been started with hand mining, and the loading machines were used to drive the entries and work the rooms from this point on. This panel is shown on the map accompanying this report, and is a reproduction of the actual mine workings, showing the progress from December, 1927, to June, 1928. On this map the unshaded portions indicate the extent of the workings which had been mined by hand at the time the loading machines were installed. The heavy shading shows the area mined by two loading machines during the period of December, 1927, to May 30, 1928, and the light shading indicates the entry development for a new panel which has been driven with pit-car loaders.

From this map it will be seen that at the time the mechanical loaders were installed the panel had just been started, but had not quite reached full development with hand loading. At the end of the six-month period, or by the last of May, 1928, the entries had been driven to the panel barrier—an advancement of between 800 and 900 ft. in six months—and 26 rooms to the right and left—a total of 52—had been driven up and nearly completed. All this mining was done by two loading machines working on single shift only.

From the six-month record, which includes the period when the machines were first installed and the operation was more or less experimental, the management has figured that with mechanical loading a panel of 52 rooms—26 to the right and

left—can be driven from the main entries and all rooms completed in from six to eight months' time. Their past records with hand loading show that the usual time required for this amount of mining was about 18 months. From these records it seems clear that at this mine mechanical loading has demonstrated a rate of mining which is from two to three times faster than the rate with hand loading.

Each loading machine will usually clean up six rooms per day making a total of 12 rooms for the two machines in the panel, and during the last four months of operation the production from a panel has averaged 425 tons per day. For this daily production the past records in hand mining show that two operating panels would be required. This means that with mechanical loading the mining is concentrated into one-half of the territory which would be required for hand work.

The advantages of this faster mining rate and concentration of workings are reflected in the mining costs and have resulted in both direct and indirect savings. It is evident that a fewer number of working places for a given tonnage will decrease the cost for installing and operating track and other facilities necessary for mining. It is evident also that the faster rate of mining means a corresponding decrease in the time that the haulways and working places must be maintained. This results in a lower maintenance cost and better roof conditions, since the top is not subject to deterioration due to long periods of standing.

Operating Report

Physical Conditions

The seam has an average height of 6½ ft. The coal is of tough structure and has no regular partings, but has occasional or intermittent streaks of impurities. The top is of fairly hard slate and generally stands well in the entries without much timbering. The bottom is a medium hard clay. The seam is generally level, but local hills are sometimes encountered. Cover about 300 ft. Open lights. Entries are rock dusted and the coal is sprinkled at the face.

Mining System

The mine is worked by the advancing room-and-pillar system with mechanical loading in the rooms and entries. Panels 532 ft. wide are developed by a pair of entries in the center with rooms driven to the right and left. These are 24 ft. wide, on 40-ft. centers, and 250 ft. long; each panel works 52 rooms—26 to the right and left. No pillars are drawn and the room mining recovers about 65 percent of the coal.

Two machines are used in a panel—one on each side—and all work from the cutting to the loading is done on the day shift of eight hours. An average of six rooms is cleaned up by each machine each day, and there are usually from 10 to 12 rooms under development on each side of the panel to provide a sufficient number of working places for all operations to be carried on simultaneously and without interference.

In the first panel mined with mechanical loading the machine developed the entries and worked the rooms advancing. At the present time, pit-car loaders are being used to develop the entries in the advanced panels and mechanical loaders in these panels will be more or less confined to room work.

Cutting and Blasting

The coal is undercut 6 ft. by machine and is drilled with an electric hand drill. A crew of two men operate the cutting machine, and these are followed by a crew of two men who do the drilling, load the holes, and shoot at the end of the day shift, using permissible explosive with electric firing. Six light shots are made in a room; in hand drilling the former practice was to use three heavy shots. The coal is shattered in a standing shot and some digging is required by the loading machines.

Mechanical Loading

The loading machine works and travels on caterpillar tracks and is operated by a crew of three men—one at the control and the others usually at the head end to do what hand shoveling may be necessary to clean up the corners. The loader discharges directly into mine cars of 2½-ton capacity, which are placed one at a time by a gathering locomotive—the trip rider acting as trimmer while the cars are being loaded. One mechanic is employed for two machines to make a thorough inspection each night and do what repair work is necessary.

Hauling

A single track of 20-pound steel on 42-in. gauge is laid in each room; the track in every third room is connected by a switch to the haulage way in the entry, but the two adjoining rooms, one on the right and left, are connected to this center room by a switch through a breakthrough. As the rooms advance, the switches are moved forward to a cross cut near the face, and this arrangement provides car-shifting facilities close to the working faces of the rooms with a minimum length of gathering haul.

A gathering locomotive serves each machine and shifts single cars as loaded to the track in one of the adjoining rooms. From this point a "spike team" of mules hauls trips of four or five cars to the main line side track on the panel haulway.

Timbering

The top usually stands well, but eight posts are set in the rooms after each cut. A crew of two men do the timbering and the track work for one loading-machine operation.

Summary of Operating Crew for One Loading Machine

Day Shift:	
Loading-machine operator	1
Loading-machine helpers	2
Cutting-machine men	2
Drillers	2
Gathering motorman	1
Trip rider	1
Spike-team driver	1
Timber and track men	2
Total machine day crew	12
Night shift:	
Sprinkler	1
Mechanic	1
Total machine night crew	2

This makes a total of 14 men for the regular operating crew for each machine. Two machines work in a panel and one foreman supervises both operations.

Production Records—Four Months' Operating Average During 1928 for Two Machines

Number of days worked	90½
Total tonnage produced	38,491
Average tonnage per shift	425
Average tonnage per machine per shift	212.5

Equipment

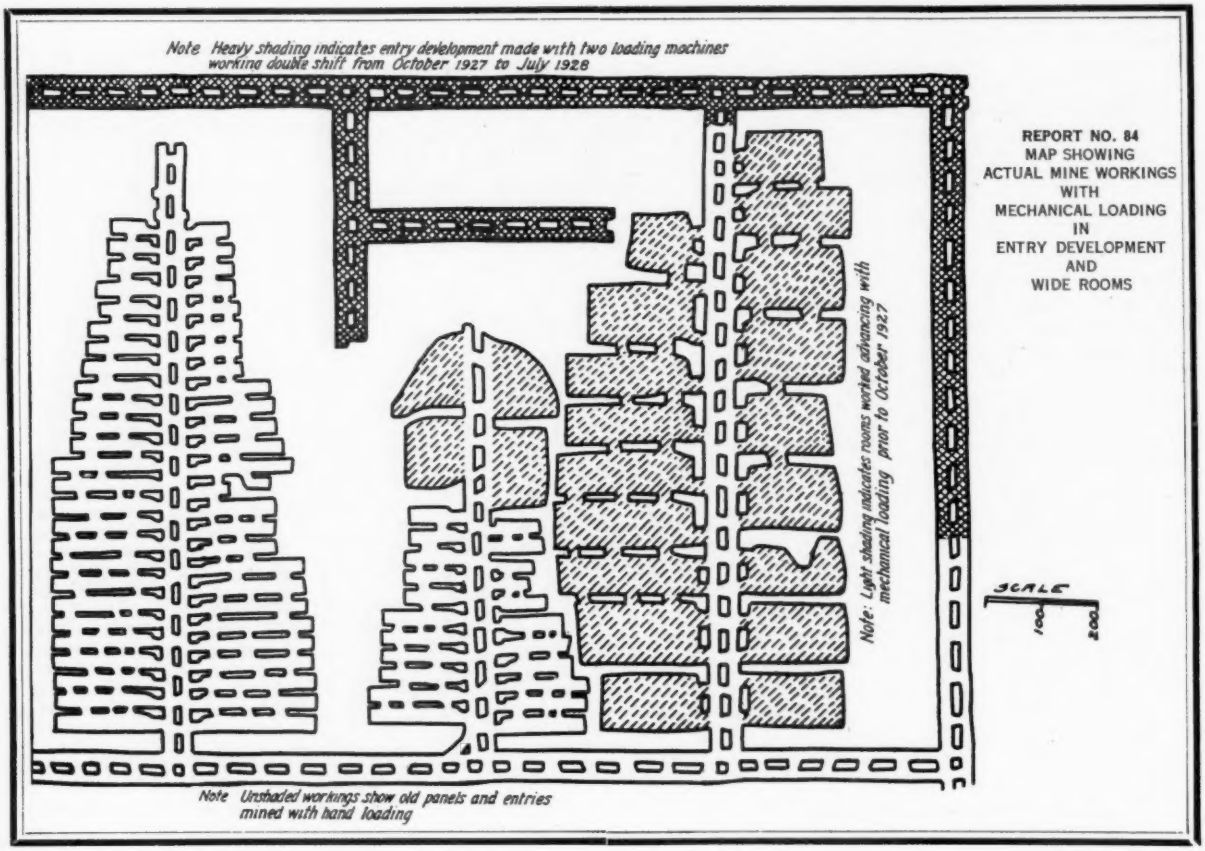
Each loading-machine operation uses 1 gathering locomotive, 1 undercutting machine, 1 electric drill, and 1 team of mules.

Preparation

The management reports that a smaller percentage of lump coal is produced with their machine operation than with hand mining, but a larger percentage of nut coal is made. The percentage of slack is about the same as in hand loading. The tipple is equipped with shaking screens and picking tables and about 50 percent more picking labor is required on the tipple than in hand mining.

Pit-Car Loaders

Pit-car loaders are now used in entry development and are operated by a regular crew of 6 men, consisting of 1 cutting-machine runner, 4 miners who drill, shoot, shovel, extend the track, etc., and 1 driver. Usually six entries are taken as the operating territory for one machine and an average of three places is generally loaded out during each shift. All operations are carried on more or less continuously during both the day and night shifts, with the cutting, track work, etc., in the other working places in advance of the loading.


Note Heavy shading indicates entry development made with two loading machines working double shift from October 1927 to July 1928
REPORT NO. 84
MAP SHOWING
ACTUAL MINE WORKINGS
WITH
MECHANICAL LOADING
IN
ENTRY DEVELOPMENT
AND
WIDE ROOMS
Note: Light shading indicates rooms worked advancing with mechanical loading prior to October 1927
SCALE
100
200
Note Unshaded workings show old panels and entries mined with hand loading

MECHANIZATION REPORT NO. 84

By G. B. SOUTHWARD

REPORT NO. 84 describes a long face modification of room-and-pillar mining with mechanical loaders in a seam 5 ft. high. This mine was worked on the room-and-pillar system with hand loading until about three years ago, when mechanical loaders were first installed. Hand loading has been entirely eliminated and all coal now mined is loaded by machines.

In hand mining the rooms were worked 20 to 25 ft. wide leaving a pillar from 10 to 15 ft. thick between. With mechanical loaders it was found that their rapid rate of mining—combined with a rather strong top—made it practicable to work a much wider place than was the practice with hand loading and in the system first developed for mechanical loading, the rooms were driven 125 ft. wide with the top supported on timbers. A panel mined in this way is shown by the light shading on the mine map and the operation was described in our Mechanization Report No. 2. About one year ago the management decided to change to a retreating system, as their operations which showed that with mechanical loading the entries could be driven at a sufficiently rapid rate to make a retreat mining system feasible. The present method of working the rooms in a retreating panel was modified from the original advancing plan and is shown in Fig. 2. This figure is sketched from the mine map and while it is not an exact reproduction of the actual workings, it shows within a fair degree of accuracy the progress and the area mined in one panel during a nine months operation. The entry development was started off the main headings in the early part of October, 1927, and drove a distance of 1,000 ft. to the panel barrier; the rooms were then started retreating and by July 1, 1928, the areas to the right and the left of the entries were mined out to the approximate extent as shown in the sketch.

Entry Development and Retreating Long Face Mining With Mechanical Loaders

In this panel one machine working on double shift was used for the entry development and two machines—one on each side of the entries—working single shift were used on the faces. If the mining continues at this same rate, as it has done since July 1, it is evident that this panel will be completely worked out during September, 1928, or within less than one year from the time the entries were started off the main headings. With hand mining the management estimates that from 18 months to 2 years would be the minimum time in which a panel of this size could be developed and completed.

In October, 1927, a pair of entries were started with mechanical loading to open a territory which lay in behind some old workings. The map shows these old workings and the amount of entry driving which was necessary to reach the solid coal areas. The ad-

vancement made during the nine-month period, from October, 1927, to July 1, 1928, is indicated by the heavy shading on the map and amounted to nearly 4,000 ft. in each entry; this was done by two loading machines working double shift and, including the cross cuts, each machine drove a total distance of about 5,000 ft. On a straight full-time basis, and not making any allowance for all delays of every nature which occurred during that period, this figures an advance of 11 ft. per machine per shift, but an actual clean up of between two and three cuts per shift, making an advance of from 15 to 18 ft., is reported as a fairly representative performance.

Several advantages of the fast mining rate as illustrated in this operation are reported by the management. The comparatively short time required to develop and mine out a panel results in a very apparent reduction in the cost of maintaining the track and roof in the haulageways and rooms and has further resulted in a higher coal recovery. In this particular mine the fast rate of entry driving has made it possible to reopen a territory behind old workings, as shown in Fig. 1, which might otherwise have been abandoned if necessary to depend on the slow and expensive method of driving the entries by hand.

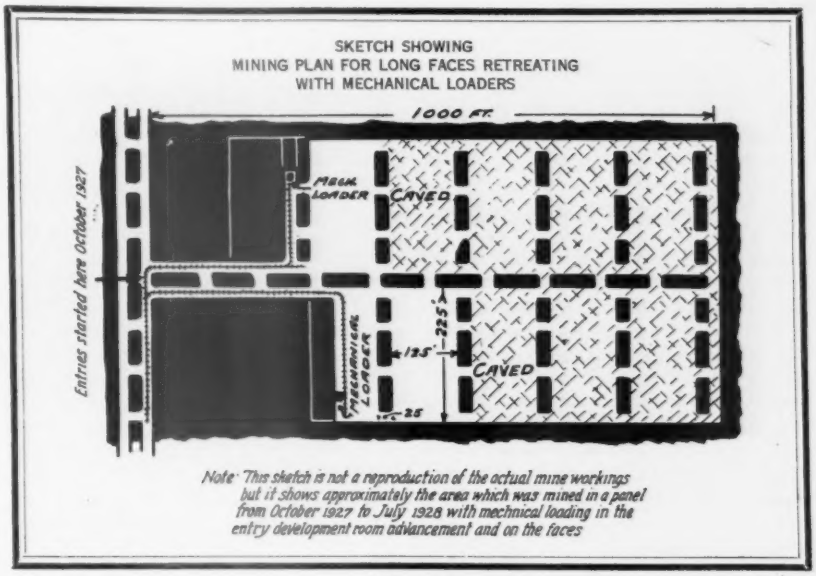

SKETCH SHOWING
MINING PLAN FOR LONG FACES RETREATING
WITH MECHANICAL LOADERS
1000 FT.
Entries started here October 1927
MECH. LOADER
CAVED
MECHANICAL LOADER
125'
225'
CAVED
25
Note: This sketch is not a reproduction of the actual mine workings but it shows approximately the area which was mined in a panel from October 1927 to July 1928 with mechnical loading in the entry development room advancement and on the faces

Figure 2

Operating Report

Physical Conditions

The seam is 5 ft. high, hard coal with no regular partings. The top is a strong slate which stands well over large areas without much timbering. Hard bottom. Seam nearly flat. Cover 200 to 250 ft. Open lights.

Mining System

The mining system is a long face modification of room and pillar in which a narrow room is driven about 225 ft. long and then slabbed to a width of 125 ft. This area is then abandoned and another narrow room is driven, leaving a 25-ft. pillar next to the mined area. Only one place is worked at a time off one side of an entry and a panel is mined retreating, driving the entries to the panel limit before the rooms are started. It has been found that a room length of 225 ft. slabbed to a width of 125 ft. is about the maximum mined area that can be held open. The entry development and the room work is all done with mechanical loading.

Cutting, Drilling, Blasting

All coal is machine undercut to a depth of 6 ft. In the entries this is made by a cutter bar on the loading machine, but in the rooms a regular undercutting machine is employed, and two men do the cutting, drilling, and shooting for one loading unit on a face. The coal is shot with carbon dioxide cartridges, which are prepared at a charging station under ground and brought to the working place ready for use. Shot holes 3½ in. in diameter are made by an electric drill, and are spaced along the face from 12 to 15 ft. apart. Occasionally a face will break down in a solid mass after an undercut has been made, and in such cases it has been found that by scraping out a small space in the bug dust and firing the cartridge underneath the coal a shot will be just as effective as in a regular drilled hole.

Mechanical Loading

The loader sets on the bottom and is moved across a working face in much the same manner as an undercutting machine and loads directly into the mine cars. Three men operate the machine, one at the control, one at the head end, and the third trimming the mine cars.

A machine is worked on a double shift to advance a room or entry and usually remains in one place until it has been driven to its limit. In this class of work the machine uses its cutting bar and does the cutting and loading during the shift, making as many cycles as possible. The face mining is usually worked on single shift and all operations are carried on simultaneously and continuously. Since the roof is held and not caved until a face is abandoned, it is not necessary to make a complete cycle of operations during a shift.

Haulage

A gathering locomotive serves each loading machine. On the faces a trip of 10 cars is placed at one time and is moved past the machine while loading. In the entry work single cars are placed and shifted out to a side track in a near-by breakthrough. The mine cars are of 2¼ tons capacity.

A track of light steel is laid parallel to and about 20 ft. back from the face; after each cut is loaded out this is moved forward in a single unit.

Timbering

As the face advances, the top is supported on round timber posts 5 to 6 in. in diameter, set about 5 ft. apart in rows. The first permanent row is maintained back about 25 ft. from the face across the track, and in the space between there and the face temporary posts are set and moved during the cutting, loading and track-shifting operations. After a room is driven up it is kept open as a return airway while the adjoining room is being driven. In the second room above the one which is working the timbers are removed and the top caves.

The 25-ft. pillar, which is left between the adjoining rooms, has been found sufficient to break the top in an abandoned room and to prevent roof weight from carrying over unto the adjoining places.

Summary of Operating Crew

Room work—on day shift only:

Machine operator	1
Machine helper	1
Car trimmer	1
Cutting, drilling and shooting	2
Timberman	1
Gathering motorman	1
Total on day shift of 8 hours.	7

Entry work:

Machine operator	1
Machine helper	1
Car trimmer	1
Gathering motorman	1
Total on each shift of 8 hours.	4

Equipment

Each operation uses one loading machine, one electric drill and one gathering locomotive. In room work one cutting machine is used.

SAND FLOTATION APPLIED TO COAL WASHING

(*Continued from page* 727)

ples of the raw coal from the mine cars indicate a sufficiently low fine coal content to justify by-passing.

This system of by-passing the fine coal, to avoid moisture and sludge troubles, has often been practiced in washing plants employing other processes, but with only a small part of the benefit possible in a sand flotation plant, because with these other processes a large quantity of fine coal is produced by degradation in the washing process itself, so there is still a large quantity of sludge and wet fine coal to be contended with. With sand flotation the degradation is negligible and but little fine coal is produced thereby.

It should be understood that sand flotation can treat fine coal and in anthracite practice is so doing, and that by-passing fine coal is advocated because of the great commercial benefits that result from the reduction in moisture in the product and avoidance of the troubles experienced in sludge recovery and dewatering.

The margin of profit in bituminous operation is small and any additional processing of the coal other than that essential to its cleaning rarely can be justified. Hence the gains to be expected from the washing of fine coal requiring extensive draining or drying equipment (or the dry cleaning of such fines with the necessary dust reclamation plant) should be carefully balanced against the increased costs due to the operation of the additional plant.

Operating Efficiency

That sand flotation is a true float-and-sink process reproducing commercially the results of the laboratory float-and-sink test is indicated by tests made during the washing of 227 tons of 2¾-in. x 0 West Virginia high volatile slack (noted before), which gave the following results:

FLOAT-AND-SINK TEST ON COMMERCIAL PRODUCTS

Sand flotation cones operated at 1.40 sp. gr.
Carbon tetrachloride test solution at 1.40 sp. gr.

Sample	Percent float	Percent sink
2¾" x 1" washed coal	99.25	00.75
1" x ¼" washed coal	100.00	Trace
2¾" x 0" refuse	1.20	98.20

Effect of Cold Weather on Plant

There has been no difficulty from this cause, even though some of the plants are located on high mountain plateaus exposed to a wide sweep of wintry winds. One anthracite plant, at Beaver Brook, handles open-cut coal and old refuse bank material, in addition to the mine product, all winter. At some plants thaw-houses are provided to store the loaded mine cars over night so that they can be dumped in the morning without passing solid masses of frozen coal, clay and refuse into the plant. The plants are, of course, heated, but not to any greater degree than in the old jig-operated units.

Increase in Operating Time

We have found that the superior product produced by sand flotation finds such ready sale as to materially increase the working days per month. Thus at Mount Union the average time during the six summer months increased to 22.8 days. This is naturally reflected in the annual tonnage produced per year and at Mount Union the yearly output was increased 16 percent with the same mine equipment, miners' houses, etc., the overhead being so reduced by this great divisor as to afford a substantial offset to the washery cost.

GENERAL COSTS

The total cost of breaker operation with properly designed anthracite sand flotation units will run from about 20 cents per ton of coal shipped to 35 cents, depending on character of plant, type of feed, labor and plant load factor. Bituminous operating costs should run from 5 cents to 15 cents, including lump-picking labor. Of this total cost, the operating cost of the sand flotation cleaning system is but a small part and likewise varies with the local conditions. Thus at one anthracite plant the average annual cost of operation and maintenance for the cones, including sand pumps and sand handling has been less than 2.80 cents and at another plant this cost averaged under 7.25 cents.

That neither the cost of sand nor the operating and maintenance cost of the sand pumps used in the process need be a considerable item is indicated by the sand cost of .63 cents per ton of coal shipped and the total operating and maintenance sand pump labor and material cost of 1.06 cents reported at one large sand flotation breaker.

The total cost of sand and all tipple supplies and material at the Mount Union plant averaged less than 1.75 cents per gross ton of coal shipped.

WATERWAY REPORT

The Department of Commerce has completed a survey of potential tonnage available for transportation by water, and by rail and water to and from Huntington, W. Va., on the Ohio River, at the request of the Chamber of Commerce of Huntington. It shows a potential tonnage of 337,984 tons of inbound traffic and 162,852 tons outbound traffic annually. The present water-borne tonnage is negligible. The survey was made to enable Huntington to ascertain the type of terminal to accommodate prospective cargo movement. The commodities covered by the survey include brick and tile, cement, lime, refractories, dyes and chemicals, earthenware, electrical goods, glass, iron and steel, lumber, machinery, nickel and sand products, petroleum, stoves and ranges. The survey shows that coal will be the greatest tonnage. Due to lack of present terminal facilities and ex-river freight rates it has been impossible for operators to prepare reliable estimates, for which reason figures on coal are omitted, as estimates would have been too illusory. The survey also shows potential tonnage between Ohio and Mississippi River points from the Pacific Coast to Huntington, between the Pittsburgh district and Ohio River points, and between other districts.

GEOLOGIC SURVEYS

Forty or more scientists of the United States Geological Survey are making surveys throughout the country as the basis for determining the probable mineral character and value of the public domain. The greater part of this geological work is in the Western States, where interest in mineral resources is keener than in the East. Four geologic groups are in Montana. Two of these, under the direction of geologists experienced in metals, are conducting surveys in the region tributary to Helena. In southern and east-central Montana two groups are mapping coal fields.

In central Idaho one geologic party is studying deposits of metals, and another party in eastern Idaho is mapping phosphate deposits.

In southeastern Utah surveys will be conducted along the canyons tributary to the San Juan and the Colorado to Navajo Mountain in the interest of developing oil resources.

In an adjacent area in northwestern New Mexico another geologic party is studying the coals of the great San Juan Basin. In the Magdalena mining district cooperative work is being carried on with the State Bureau of Mines and Mineral Resources. Work on the Santa Rita mining district is being completed and attention is being given to potash deposits in the great salt basin in the southeastern part of the State.

In Colorado attempt is being made to apply geologic research directly to the problem of ore finding.

In Texas progress is being made in preparing a new geologic map of the State on a scale adequate for the use of the petroleum industry.

In northern Arkansas a study is being made of possible lead and zinc deposits.

Iron ores of the South are receiving constant attention from the Survey.

OIL SHALE MINING BY STRIP METHODS

(*Continued from page* 668)

This opinion of course refers to the deposits in Colorado, Utah, and Wyoming.

Eastern States, Particularly Kentucky

In many of the eastern states the black oil shales overlie coal beds and are removed with the coal in open-pit or stripping operations. In such cases, or in similar cases where the shale lies close to the surface, it is probable that shovel operations will be feasible. In this connection the opinion of C. S. Crouse, head of the Department of Metallurgical Engineering, University of Kentucky, who contributed a chapter on the economic study of the black Devonian shales of Kentucky to volume 21 (1925), "Oil Shales of Kentucky," of the Kentucky Geological Survey, may be cited:

Geologic changes, mainly erosion, left a ring of shale hills or knobs outcropping to the surface all around what is known as the Blue Grass section of Kentucky, but the principal outcrop is around the edge of this section. (Figure 6.) It has been conservatively estimated that the outcrop shale areas in this state amount to 100,000,000,000 tons.

The shale is rather hard and brittle when fresh. The fracture is conchoidal, with the surface of freshly broken pieces showing a velvety black color, although weathered pieces show fissibility and a grayish cast. The average weight of shale from 21 counties is 130 pounds a cubic foot. Probably it will average half a barrel of oil, 3,000 to 4,000 cubic ft. of fuel gas, and 37.7 pounds of ammonium sulfate per ton.

The topography of the shale country may be described as hills, valleys, and plateaus. The knobs mentioned rise to a height of 50 to 150 ft. and more, as shown in Figure 7, and are composed almost entirely of shale. The higher crests and those knobs which lie farther back from the outcrop are often capped with limestone. In many cases the knobs are single, although generally they are connected by ridges or hog-backs. The streams, mostly small, though some are of considerable size, have cut out valleys, many of which are rather wide and flat with their lower levels often lying below the level of the shale itself, thus furnishing ideal plant sites and making the application of gravity mining a simple problem. Excepting the valley lands, this part of Kentucky is the poorest agricultural land. The soil is never more than a few feet thick and often only a few inches, and only in Jefferson County, near Louisville, have the hills been worn down and the country flattened to such an extent that an overburden of 10 to 15 ft. of earth has been deposited over the shale. Figures 8 and 9 show typical shale occurrences and Figure 10 shows a prospect shaft in shale.

The shale area is rather plentifully supplied with railroad transportation and good highways.

[In "The Topography of Kentucky," volume 30 (1927) of the Kentucky Geological Survey, by W. R. Jillson, pages 275-288 review the geology of the oil shales of the eastern United States. A map (Figure 3) and photographs show the extent and features of the shale lands, and should be of value as a reference.]

Fig. 10—Prospect shaft in Kentucky shale

The Kentucky shale formation lies in a nearly horizontal position with, in general, virtually no overburden, and what there is consists largely of a few feet of weathered and decomposed shale. This cover will seldom have to be removed separately, but can be mined with the shale itself and fed direct into the retorts. For this type of deposit, quarrying or open-pit methods of mining will prove to be by far the most economical and practical. The topography will decide which of these is suitable. If the shale occurs in hills, as is usually the case, quarrying with or without steam (or electric) shovels, may be employed; but if the tract is level, an open-pit system, with the use of these shovels, is indicated. The cost of loading by shovels, exclusive of drilling and blasting, is estimated at 5 to 7 cents a ton of shale for 1,000 or 500 tons per 10-hour shift; although these costs may be affected by local conditions.

Indiana

According to Ralph Esarey, of the Department of Geology, University of Indiana, who largely summarizes the thesis (1923) of J. R. Reeves, "Oil Shales of Indiana," in THE MINING CONGRESS JOURNAL for January, 1928, more than 45,000,000,000 tons of oil shale is available from the outcrop of one formation—the New Albany black shale. It will average 12 gallons of oil per ton. This particular deposit extends from the center of the state to the border of Kentucky. (See Figure 3.) The shale is hard and brittle, and breaks with an irregular fracture. According to this report, the shale could be mined by the stripping method or by quarrying. An average of less than 10 feet of overburden covers the entire area. In general, it consists of soil and mantle rock.

ACKNOWLEDGMENTS

Thanks are due to the following engineers for their opinions: M. J. Gavin, refinery engineer in charge of the Government oil-shale plant at Rifle, Colo., and W. R. Crane, mining engineer, both with the Bureau of Mines; C. L. Colburn, mining engineer formerly with the bureau; and C. S. Crouse, head of the Department of Metallurgical Engineering, University of Kentucky.

IMPROVED MARKETING FACILITIES FOR COPPER

(*Continued from page* 655)

consumers' hands. For some time in this country a change in buying policy has been taking place in nearly all important commodities. Instead of carrying stocks of from two to six months' requirements, as has been customary, all the large industries have changed their plans to carrying the minimum amount of stock required to carry on the plant most economically, thus throwing the burden of carrying stocks back to the producer. The economical advantage of this change can not be denied, although it was somewhat difficult for the producers to adjust themselves to it, and this also accounted in a large measure for the lower prices prevailing in 1927. Now this change having run its course and the producers having become accustomed to the new conditions, the price has gradually recovered.

A glance at the figures of the world stocks as of January 1 for the past five years as given below will be interesting.

	1923	1924	1925	1926	1927	1928
North and South America	344,494	409,265	373,962	321,957	358,636	343,718
Great Britain	29,994	34,754	43,029	62,773	38,792	12,221
France	3,746	2,091	8,042	3,375	9,688	1,384

These show that while there was the ordinary fluctuation in stocks in North and South America, those of Europe suffered a gradual decline. These European figures represent only the stocks in public warehouse. The reduction of these, taken in conjunction with the depletion of stock in consumers' hands, resulted in a serious shortage over there. The domestic consumers having also allowed their stocks to run down to an uncomfortably low level (in the readjustment move above referred to) resulted in a very keen demand the past few months for prompt copper and a consequent hardening of the price. This only demonstrates that whilst it may have been wise for them to reduce their inventories, they doubtless allowed the reduction to go too far. The producers have done all they could to meet the emergency that has arisen both here and in Europe, with the result that the more ugrent demands have now been fulfilled and the market has again settled down to quiet, stable conditions.

With the expansion of the electrical industry both here and in Europe and the development of water power all over the world, requiring large volumes of copper for transmission lines, we can safely say that the prosperity of the industry seems pretty well assured for some time to come.

Anaconda Buys Clark Interests

The Anaconda Copper Mining Company has purchased for cash all the Montana interests of the estate of the late W. A. Clark except the Missoula Public Utilities, according to advices from Butte.

The sale was effected at the instance of about 80 percent of the stockholders of the companies taken over, said an official announcement by C. F. Kelley, president of Anaconda, and Robert E. Tally, president of the Clark-Montana Realty Company.

The companies and properties sold are the banking business of W. A. Clark & Brother, the Elm Orlu Mining Company, the Moulton Mining Company, the Butte Electric Railway Company, the Miner Publishing Company, the Montana Hardware Company, the Montana properties of the Clark Montana Realty Company, the Western Lumber Company, and the Timber Butte Milling Company.

A large part of the stocks of these companies is held in trust by trust companies in New York and New Jersey.

In his statement, Mr. Kelley said:

"In view of the importance of the transaction, Anaconda believes that by merging the respective operations, the interests acquired can be made not only profitable to it but also to contribute a more lasting and greater importance to the industrial prosperity of the State than under any other arrangement.

"Among the properties conveyed are a large number of undeveloped mining claims favorably situated in the Butte district, upon which active work will be undertaken, in the expectation that by so doing miners will be added to the pay roll and the permanence of Butte's mining industry may be more fully assured."

Mr. Talley stated: "For a number of years the Clark estate trustees have been desirous of liquidating the investment in companies involved in the sale, and this spring other heirs of the lat Snator Clark joined in insisting that the properties be sold. Anaconda was approached as the most logical purchaser, but Anaconda in no way influenced either the decision of the Clark interests to sell nor their request to Anaconda to negotiate for the properties. The operations of these properties will be continued under the management of Anaconda, and as many of the employes will be retained as is consistent with efficient management. The most important mines owned by the Clark interests in Montana, the Original and Stewart, were sold to Anaconda some years prior to Mr. Clark's death."

Although the price paid for the properties has not been disclosed, estimates range from $6,000,000 to $9,000.000. This is not regarded as likely to involve additional financing by Anaconda, as it is understood the company's treasury will be able to finance the deal.

Smelter and Power Plant for Hudson Bay Mining Syndicate

Plans for a smelter at the Flin Flon mine of the Hudson Bay Mining and Smelting Syndicate have been completed and material for the plant will be sent to Flin Flon during this fall and winter. Power for the Flin Flon property will be developed at Island Falls, on the Churchhill River by the Churchhill River Power Company, Ltd., which is closely affiliated with the Hudson Bay Mining Syndicate. The plant will also supply power for public use in the province of Saskatchewan.

New Equipment at Shattuck Denn

Preparation is being made for the installation of a new hoist at the Denn shaft of the Shattuck Denn Mining Corporation, at Bisbee, Ariz. A new and larger hoist became necessary for the exploitation of the new ore body recently found in development work on the 2,000 level and in diamond drill holes from the 2,000 level to the 2,200 level. The collar of the shaft has been concreted and the foundations for the hoist completed. Sinking of the shaft from the 2,000 level to the 2,200 level is in progress.

Louis d'Or Property Near Miami, Ariz., Sold at Public Auction

The property of Louis d'Or Mining and Milling Company, on Sleeping Beauty Mountain, near Miami, Ariz., was sold at public auction at Globe, Ariz., for $100,000. The purchasers were George M. Eggleston, Orrin P. Peterson and L. W. Witmer representing the chief creditors of the company.

The Louis d'Or property was partly developed by drilling some years ago. On the basis of 12 drill holes the company issued estimates of 150,000,000

MINE PRODUCTION OF GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH IN 1927

(In terms of recovered or recoverable metal)

Advance figures by C. N. Gerry, of the United States Bureau of Mines, Department of Commerce.

County	Number of producers	Ore treated	Gold	Silver	Copper	Lead	Zinc	Total Value
		Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds	
Beaver	6	9,357	325.71	46,617	53,459	1,186,328	97,886	$121,172
Box Elder	4	126	.68	52	11,320	19,292	.....	2,741
Garfield	1	10	3.77	.....	.....	.....	.....	78
Juab	28	300,501	21,768.70	4,165,136	3,209,707	37,452,242	1,051,534	5,658,891
Morgan	1	127	.78	472	298	41,803	.....	2,957
Piute	1	35	12.24	229	31	4,920	.....	697
Salt Lake	35	14,524,824	124,550.19	3,734,478	250,172,078	113,153,693	49,134,361	47,737,954
Summit	8	347,087	4,170.80	3,175,129	1,244,634	40,137,322	12,391,525	5,371,271
Tooele	23	68,790	3,906.96	287,613	229,816	15,207,230	4,045,448	1,490,912
Utah	12	146,953	11,042.27	3,437,086	661,150	52,699,257	.....	5,583,756
Wasatch	4	359,264	28,126.72	3,760,138	1,350,785	42,667,953	32,464,689	7,656,203
Total, 1927	123	15,757,074	193,908.82	18,606,950	256,933,278	302,570,040	99,185,443	a 73,626,632
Total, 1926	166	15,856,144	c 182,762.98	c 19,358,581	257,464,482	295,270,025	95,179,380	b 82,662,884

a Average value of metals: Gold, $20.671835 per ounce; silver, $0.567 per ounce; copper, $0.131 per pound; lead, $0.063 per pound; zinc, $0.064 per pound.

b Average value of metals: Gold, $20.671835 per ounce; silver, $0.624 per ounce; copper, $0.14 per pound; lead, $0.08 per pound; zinc, $0.075 per pound.

c Includes placer production.

tons of ore as partly developed. The grade of this ore was said to be from 1 to 1.5 percent. The optimism required for such an estimate is obvious.

Prevent Fatalities In Oklahoma Mines

There have been no fatal accidents in the mines of the Oklahoma section of the Tri-State district since the beginning of the statistical year on July 1, as compared with eight in July and August of last year, Riley Clark, mine inspector for the third district told safety engineers at a meeting of the Tri-State Zinc and Lead Ore Producers' Association.

Riley reported more than 6,000 men as being employed in the Oklahoma lead and zinc mines at present as compared with about 5,000 in the corresponding period of last year, which makes the record all the more impressive.

Seek to Stabilize the Lead Market

Lead producers throughout the world are reported planning a conference in London about the middle of September to discuss production, marketing and consumption of lead with a view to working out a program looking toward stabilization of the market. Verification of the rumored conference is lacking although it is reported that American interests will be parties to the conference.

For some time past American producers have been promoting an institute designed to further the industry from producing and consuming standpoints. In view of this it is thought that possibly the rumored London conference is related to the movement under way in this country.

Urge Mileage Basis for Iron and Steel Freight Rates

Establishment of a mileage scale of rates on iron and steel articles throughout all territory north of the Ohio and east of the Mississippi Rivers, including New England, is recommended in a proposed report issued by the Interstate Commerce Commission, following a general investigation under the Hoch-Smith resolution. The report was submitted by Examiners Howard C. Faul and C. M. Bardwell, and is the first that has been made in the general rate structure investigation.

The report states that no depression is apparent in the steel industry, but the effect of the proposed findings, if adopted by the commission, would be to reduce slightly the railroad revenues on this traffic and the readjustments would involve both increases and decreases in rates. The report states in this connection that the scale recommended represents an attempt to offer a more consistent and equitable rates structure that is now in effect and one "which will make only such reductions in the carriers' revenue as must result from the application of what from all the evidence seem to be maximum reasonable rates."

125 Mills Running In Tri-State Field

The number of mills operating in the Tri-State district (Oklahoma-Kansas-Missouri) increased to 125 the third week of August, the highest number of the year, and the largest number in operation since the week ending December 17, 1927, according to the bulletin of the Tri-State Zinc and Lead Producers' Association.

Despite the larger number of mills operating, output dropped slightly, being 12,877 tons, as compared with 12,895 tons in the previous week. Lead output also was off, being 1,677 tons, as compared with 1,679 tons in the preceding week.

Michigan Tech Professor Patents Yieldable Metal Support for Mines

A patent on an invention of great interest and importance to miners has been granted to Roland D. Parks, assistant professor of mining at the Michigan College of Mining and Technology. The invention consists of a yieldable metal support for use in withstanding the ground subsidence pressures which are encountered in all mines.

Subsidence pressures are unavoidable because there is no way of preventing ground movement; the movement is slow, but it is irresistible. It is impossible to hold the ground rigidly in place, and a mine support can not be designed which will hold immovable the pressures at deep levels.

Professor Parks has developed a means of overcoming the rigidity of metal supports while retaining their natural strength. The device consists of two pieces of metal which slide one within the other when subjected to pressure. The sliding action is controlled by a third piece of metal interposed between the two in such fashion that it retards the sliding process.

The invention is the result of research which Mr. Parks began in 1924 in the mining department of the University of Wisconsin. The principle involved is one of fundamental importance in mining practice, and the invention is receiving the enthusiastic support of engineers who have had an opportunity of studying it.

MINE PRODUCTION OF GOLD, SILVER, COPPER, LEAD AND ZINC IN IDAHO IN 1927

(In terms of recovered or recoverable metal)

Advance figures by C. N. Gerry, of the United States Bureau of Mines, Department of Commerce.

County	Number of producers	Ore treated	a Gold	a Silver	Copper	Lead	Zinc	Total Value
		Short tons	Fine ounces	Fine ounces	Pounds	Pounds	Pounds	
Ada	4	172	82.14	37	19	257	.....	$1,738
Adams	1	11	.24	57	3,370	.....	.....	478
Bear Lake	1	20	.....	40	.....	29,624	.....	1,889
Blaine	11	5,466	68.11	83,392	3,116	1,105,907	1,274,467	200,337
Boise	34	6,662	7,365.06	18,264	3,969	135,626	.....	171,670
Bonner	7	3,557	2.95	120,594	3,142	2,099,817	.....	201,139
Bonneville	2	.....	19.54	.....	.....	.....	.....	404
Boundary	1	7,920	.....	17,409	.....	935,053	.....	68,779
Butte	2	7,908	6.63	43,493	1,359	2,363,805	.....	173,896
Camas	1	14	1.02	984	86	1,156	1,527	761
Canyon	1	.....	2.08	.....	.....	.....	.....	43
Clearwater	4	.....	60.08	9	.....	.....	.....	1,247
Custer	12	45,298	946.65	134,170	696,830	3,415,556	18,163	403,270
Elmore	10	55	3,888.14	1,256	.....	.....	.....	81,087
Gem	1	3,400	639.76	11,380	1,855	42,400	.....	22,591
Idaho	24	650	667.53	245	.....	.....	.....	13,938
Latah	2	.....	16.83	1	.....	.....	.....	349
Lemhi	24	17,056	696.55	207,522	152,156	7,987,520	.....	655,210
Owyhee	12	344	239.12	6,132	79	1,716	.....	8,538
Shoshone	54	1,919,309	415.83	8,256,126	1,306,773	283,896,615	52,262,188	26,091,275
Twin Falls	2	.....	7.64	.....	.....	.....	.....	158
Valley	5	458	187.89	112	.....	.....	.....	3,948
Washington	3	25	1.89	186	409	23,371	.....	1,670
Total, 1927	218	2,018,325	15,315.67	8,901,409	2,173,163	202,038,423	53,556,345	b 28,104,413
Total, 1926	246	1,934,143	13,669.27	7,556,444	1,337,442	272,980,212	52,614,691	c 30,969,551

a Includes placer production. b Average value of metals: Gold, $20.671835 per ounce; silver, $00.567 per ounce; copper, $0.131 per pound; lead, $0.063 per pound; zinc, $0.064 per pound. c Average value of metals: Gold, $20.671835 per ounce; silver, $0.624 per ounce; copper, $0.14 per pound; lead, $0.08 per pound; zinc, $0.075 per pound.

World Manganese Output

Approximate world output of manganese ore with a metallic content of 30 percent or more was 3,318,773 long tons, gross weight, during 1926, according to the Minerals Division, Department of Commerce. Of this total 93 percent was produced by five countries which consume annually but a comparatively small portion of their own output—40 percent by Russia, 30 by India, 11 by the Gold Coast, 8 by Brazil, and 4 by Egypt.

At the same time 1.4 percent of the world's total was produced in the United States, 1.33 in Spain, and 1.26 in China. The remaining 3 percent was produced by 20 other countries, of which Sweden, Cuba, Chile, Italy, Japan, and Java are the more important.

Approximately 68 percent of the total world output of manganese ore is consumed by seven outstanding industrial nations. The approximate percentage of total world production consumed by these countries is as follows: United States, 22 percent; France, 17; United Kingdom, 10; Belgium, 8; Germany, 6; Japan, 3; and Italy, 2. Although the above percentages are based on 1926 statistics, the relative positions of producing and consuming nations have varied little in recent years.

Prominent Mining Experts Address Metal and Mining Shares Meeting

A number of internationally known mining engineers and mining investment specialists addressed a meeting which was held at the Bankers' Club, New York, on August 1. The object of the conference was to explain to a group of approximately 100 security dealers the method of operation of Metal and Mining Shares, Inc., New York City, an investment company, the purpose of which is to provide a safe medium for investing in mine securities.

Mr. Thos. F. Cole, at present director of New Cornelia Copper Company and Calumet & Arizona Mining Company, addressed the group on the mineral wealth of the United States. He particularly stressed its position with regard to iron. He was followed by Carl O. Lindberg, consulting mining engineer, who stressed the importance of modern mining methods and their beneficial influence on mine values.

Other speakers were Mr. Roy Barton White, president of Central Railroad Company, of New Jersey; Mr. D. O. Baudouy, representative in the United States of various French and South American interests, and Mr. John G. Baragwanath, consulting mining engineer.

During the luncheon which followed Commander Richard E. Byrd was presented. Commander Byrd spoke at length about the expedition to the South Pole which he commands and which is now under way.

ANACONDA COPPER TEAM AGAIN WINS FIRST-AID CONTEST AT INTERNATIONAL MEET AT BUTTE

IN the competition at the Seventh International First Aid and Mine Rescue Meet, held September 20, 21 and 22 at Butte, Mont., a team from the Zinc Plant at Great Falls, Mont., of the Anaconda Copper Mining Co., attained the highest honors in first aid. The same company won the competition of 1927. The meet was held under the auspices of the United States Bureau of Mines and sponsored by various mining, industrial and civic organizations of Montana. The winners of the several contests follow in the order of their success:

First Aid—Great Falls Zinc Plant, of Anaconda Copper Mining Co.; Baton Rouge Plant of Standard Oil Co.; and Great Falls Furnace Refinery team of Anaconda Copper Mining Co.

Mine Rescue—Roslyn, Wash., team of Northwestern Improvement Co. of Seattle (Northern Pacific Railroad Co. coal mining subsidiary); Carterville, Ill., team of the Madison Coal Co.; and the Consolidated Coal Co. of Acosta, Pa.

Combination First Aid and Mine Rescue—The Roslyn team of the Northwestern Improvement Co.; the Carterville team of the Madison Coal Co.; and the Acosta, Pa., team of the Consolidated Coal Co.

The presentation of awards was made the evening of the 22d at a dinner tendered all contest participants, judges and visiting officials by the Anaconda Co. Attorney W. W. Gale, of Billings, Mont., was toastmaster, and the speakers included W. B. Daly, general superintendent of mines of the Anaconda Co., and Dr. F. A. Thompson, president of the Montana State School of Mines, both of whom spoke in praise of the meet; Edwin Young, chief safety engineer of the Anaconda Great Falls plant, who stressed the psychological effect of safety; and R. R. Sayers, chief health and safety engineer of the U. S. Bureau of Mines, who praised the Montana enterprise that made the meet a success.

A silver loving cup was awarded to the winning team in the first-aid contest by the National Coal Association. This was presented by Harry Gandy, Jr., with brief but appropriate remarks concerning the splendid achievement of the team making the highest first-aid record at the meet and the intense interest of bituminous operators in the safety movement and in the health and welfare of their employes.

Washington Daily News

Zinc-Dust Precipitation of Copper From Cyanide Solution

If zinc dust be used to precipitate copper, gold, and silver from cyanide solution where the copper content accounts for excessive cyanide loss during the leaching period, the reuse of the cyanide solution will soon result in it becoming fouled with zinc. As the percentage of zinc in the cyanide solution increases, the reuse of these solutions results in corresponding decrease in the extraction of the metals, particularly silver.

Studies conducted by the Rare and Precious Metals Experiment Station of the Bureau of Mines, Reno, Nev., show that decreased extraction is noticeable when the solution contains near 0.15 percent zinc. When it contains 0.36 percent zinc, the cyanide extraction of silver drops from 90 percent to 75 percent. This explains why zinc precipitation can not be satisfactorily used in cyanide practice when there is considerable soluble copper in the ore.

"The Retreatment of Comstock Tailings," by E. S. Leaver and J. A. Woolf, is the name of a report recently issued by the Bureau of Mines. It outlines different methods for recovery of mercury and copper from tailings.

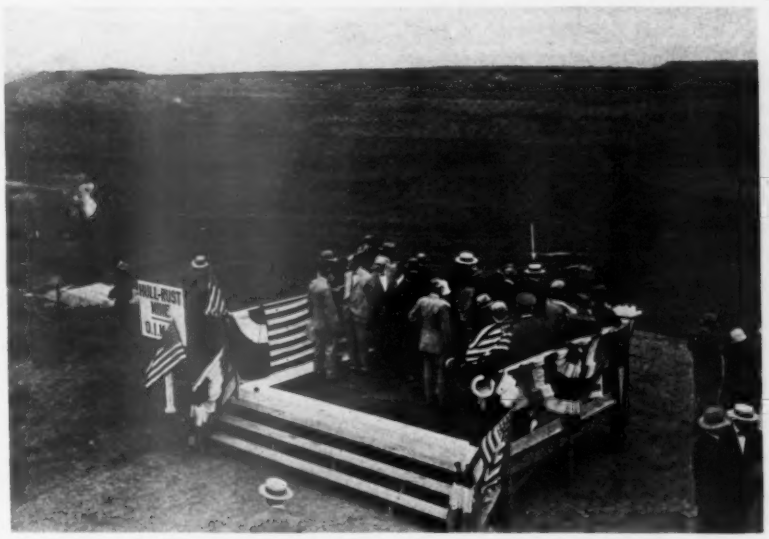
Phelps Dodge Closes Burro Mountain Branch

Suspension of all mining at the Burro Mountain branch of the Phelps Dodge Copper Mining Corporation at Tyrone, N. Mex., was announced August 22 by E. M. Sawyer, manager.

The shutdown, in all probability, Mr. Sawyer said, will continue until such a time as the copper market will require and be able to absorb additional production.

Dickens Consolidated Installing New Concentrator

Equipment for the new concentrator at the Dickens Consolidated property, near Kellogg, Idaho, is now being installed, and it is expected the plant will be ready to receive ore in a few weeks, according to advices from Spokane. Development work underground has proceeded in a satisfactory manner, the connection being completed between the 400 and 500 levels, while considerable drifting on the vein from both levels has blocked out a large tonnage of ore for the mill when that plant is ready to receive it.



International News Reel

President Coolidge and the party which accompanied him on his visit to the iron-mining country August 2. The property shown above is the Hull-Rust mine of the Oliver Iron Mining Company, at Hibbing, on the Mesabi Iron Range in Minnesota

Personal Items

W. W. Bradley has been appointed State Mineralogist of California as a successor to Loyd L. Root, who has resigned to enter private practice as a mining engineer. Mr. Bradley has been deputy state mineralogist for the past five years and a member of the department for 16 years.

D. H. McLaughlin has been in San Francisco for a short vacation after a summer of professional work in Mexico.

Dennis M. Riordan, mining engineer of San Francisco, known and loved by mining men everywhere, died recently at the age of 80.

C. Lake, mining geologist of Duluth, was in the West on professional work in August.

M. Curley, general manager of the New Cornelia Copper Company, has spent a vacation in California.

Robert Longyear, president of the E. J. Longyear Company, left early in August for a business trip to England.

Carleton Merritt, a director of the Consolidated Coppermines Company, has been at Kimberly, Nev.

W. V. De Camp, general superintendent of the United Verde Copper Company, has returned to Jerome from a trip to Honolulu.

A. H. Shoemaker, geologist for the Old Dominion Company, Globe, Ariz., has been in San Francisco.

Dr. Francis A. Thomson, president of Montana School of Mines and former dean of Mines at the University of Idaho, was married in Seattle in July to Miss Eva Michaelson, of Spokane.

Frank M. Smith, director of the Bunker Hill Smelter, is in northern Ontario, where the Treadwell Yukon, associated company of the Bunker Hill, is developing the great Errington mine.

Robert E. Tally, mining engineer of Jerome, Ariz., has been elected president of the Western Lumber Company and Missoula Public Service Company, operating in Montana, succeeding W. A. Clark, Jr.

H. R. Bell, for many years president of the Bell & Zoller Coal Company, Chicago, has been elected to the newly created office of chairman of the board. G. D. Cowin, formerly vice president, has been made president, and Paul Weir, general superintendent of mines, is now vice president.

L. C. Brunswick, a division superintendent for M. A. Hanna Company, is now connected with the purchasing department of the Pennsylvania Coal Company, Scranton, Pa.

Frank R. Wadleigh has been appointed consulting fuel engineer of the Consolidated Gas Company of New York City.

Jess Palmer, of Dunmore, Pa., has resigned his position as division superintendent for the Pennsylvania Coal Company on account of ill health.

At a meeting of the executive committee of the Williamson (W. Va.) Coal Operators Association, held early in August at Williamson, Joseph D. Artigo was named acting secretary of the organization. Mr. Artigo has been acting in that capacity since the resignation of George W. Bausewine went into effect on May 1.

J. P. Russell, formerly assistant chief engineer for the Utah Fuel Company, has become general safety inspector of the United States Fuel Company, with headquarters at Hiawatha, Carbon County, Utah.

John F. Daniel, of McRoberts, Letcher County, Ky., has been appointed by Governor Sampson as chief mine inspector of the state for a four-year term, succeeding William H. Jones, of Floyd County.

Robert A. Quin, who has been general manager of the Susquehanna Collieries Company, has been promoted to vice president by James Prendergast, president, and David A. Randall, who has been general superintendent since November 1 of last year, succeeds to Mr. Quin's former position. Mr. Quin has been general manager of the company since 1903.

Government Awards Contract for New Helium Production Plant

The awarding of a general contract for the erection of the buildings and other structures for the Government's new helium production plant, near Amarillo, Tex., to James T. Taylor, of Fort Worth, Tex., is announced by the United States Bureau of Mines, which will have supervision over the project. The time for completion of the plant called for under the contract is 75 days.

The plant site is located near the town site of Soncy about 6½ miles west of the center of the city of Amarillo. The site comprises 18½ acres of land, and was donated for the project by W. H. Bush. Arrangements have been made

with the Rock Island Company for railroad service, including the construction of an industrial side track for the plant.

In designing the plant buildings the aim has been to provide structures that would be substantial, serviceable, and adapted to future expansion at the lowest practicable cost. The mechanical equipment of the plant will consist primarily of gas engines, gas compressors, and apparatus for low temperature liquefaction of gas. Some of the equipment will be provided by moving spare units from the United States Helium Production Plant at Fort Worth, Tex., and other parts will be new.

Since the contract between the Amarillo Oil Company and the Government was executed, the company has completed an excellent gas well, which extends the proved gas area of the structure about 1 mile to the northeast of the wells previously completed. This new well came in with an open flow volume of 7,100,000 cu. ft. per day and a rock pressure of 725 lbs. per sq. in. The helium content of the gas is as high as that from other wells on the structure. A well, lying to the southeast of the existing wells, is now being drilled.

Rainey Buys Clyde Coal Property

Purchase of the Clyde Coal Company's mine and other properties at Fredericktown, Washington County, Pa., by W. J. Rainey, Inc., of New York, has been announced by James Neale, president of the Clyde Coal Company. The consideration is not made public. Accumulated coal, tipples, machinery and houses are included in the sale. The mine, fronting on the Monongahela River at the Mouth of Ten Mile Creek, boundary between Washington and Greene Counties, has a daily production capacity of 2,000 tons.

Civil Service Positions for Fuel Engineers

Open competitive examinations for the positions of fuel engineer, associate fuel engineer and assistant fuel engineer have been announced by the United States Civil Service Commission, Washington. Applications must be on file with the commission at Washington not later than September 5. The purpose of the examination is to fill vacancies in the Bureau of Mines, for duty in Washington, Pittsburgh, and elsewhere. Entrance salaries are $3,800 for fuel engineer, $3,200 for the associate, and $2,600 for the assistant. Duties of the positions are to conduct, under general direction, laboratory and field fuel investigations, especially in combustion, furnace design, smoke prevention, heat transmission, efficiency of fuel-using devices.

PROGRESS SHOWN IN MINE SAFETY RESEARCH

George S. Rice, Chief Mining Engineer of the United States Bureau of Mines, recently returned from an official trip to England, France, Belgium and Germany, undertaken to further the program of mine-safety research being conducted cooperatively with the British Government, and to observe the mine-safety methods being studied in the governmental testing laboratories of the countries named. Unanimity of opinion in the various European countries that the only practical way of combating the bituminous coal-dust mine-explosion hazard is by the rock-dusting method, was noted by Mr. Rice.

In the Ruhr district in Germany a coal mine has been converted into an experimental mine for the conducting of mine-safety investigations, so that the experimental mine of the Bureau of Mines at Bruceton, Pa., is no longer the only mine in the world devoted exclusively to scientific researches. Government officials of the different countries unofficially indicated their willingness to cooperate in every way feasible with the United States Bureau of Mines in the matter of mine-safety research.

Outstanding instances of low-cost mining methods are found in the production of brown coal in Germany by huge machines, according to Mr. Rice, whose object was in part to observe new types of mining machines and new methods of mining with reference to economy in production.

All European countries are deeply concerned in the safety, health and welfare aspect of mining. Notable instances of such interest were found in Great Britain, where, under the direction of the Safety in Mines Research Board a fine laboratory building has just been completed at Sheffield and extensive galleries and laboratories for research purposes have been constructed near Buxton. An underground explosion gallery is also under construction.

In France a new coal-dust and gas-explosion testing gallery is being constructed at Montlucon for the purpose of testing the relative explosibility of the coal dusts of all the mines of France. In Belgium the National Mining Institute has just completed at Frameries elaborate new mining laboratories and is moving its testing galleries to the new site. In Germany the Ruhr Mine Experiment Station, near Dortmund, and the Upper Silesian station at Beuthen are being enlarged. In the Ruhr the well-known Hibernia Mine, at Gelsenkirchen, has been taken over for experimental purposes by a combination of associations of the mine operators, miners, miners' insurance companies, and the Government. In Great Britain a Government committee has been appointed to consider the general matter of mine-rescue methods.

For five years the United States Bureau of Mines has carried on a successful official cooperation with the Safety in Mines Research Board of Great Britain, and the interchange of scientific personnel, apparatus, material, and information has proved of greatest benefit.

In continuation of the plan of interchange of personnel between the American and British Governments, Dr. S. H. Katz, chemist in charge of the gas masks and respirators laboratory of the Pittsburgh Experiment Station of the Bureau of Mines, has been detailed to work at the new testing station of the British Safety in Mines Research Board at Buxton, England, for a period of approximately 12 months. Within the near future, W. Payman and W. F. C. Shepherd, explosives chemists of the Safety in Mines Research Board, will be assigned to work at the Pittsburgh Station of the Bureau of Mines on the mechanism of the ignition of gases by explosives.

Washing Characteristics of Raw Coals

A complete separation of a raw coal sample from a coal mine into its specific gravity components has been made by the Bureau of Mines by the heavy solution method which will illustrate the heterogeneous character of the material called raw coal. Ten solutions ranging from 1.25 to 2.665 specific gravity were used, which divided the coal into 11 products each of which contained particles whose specific gravities varied over a comparatively narrow range. The results show that this coal contained material ranging in specific gravity all the way from less than 1.25 to more than 2.665 and that the ash content of the fractions ranges from 1.6 to 88.1 percent. The heaviest fraction (over 2.66 specific gravity) contained 17.1 percent of pyrite sulphur, which is equivalent to 32.0 percent of pyrite.

These figures indicate that too little attention is given to the proportions of materials of very high and very low specific gravities in studying the washability of a coal, for they determine in large measure how difficult the coal will be to wash. Almost any process will separate particles over 2.665 specific gravity from particles under 1.25, and if the proportions of these are large, the washing process may be quite crude and still make an efficient separation.

Southwestern Coal Operators Agree with Miners on 1917 Scale

A new wage contract based on the 1917 scale was consummated August 24 at Kansas City, Mo., between mine workers' representatives and officials of the Southwestern Coal Operators' Association. This announcement was made by W. L. A. Johnson, commissioner for the latter group, at the close of a conference which lasted several days.

Under the agreement, which was signed by representatives of both sides, the miners will receive $5 a day wages for day work. The contract becomes effective on September 1 and expires on April 1, 1931.

The mine workers had demanded a renewal of the Jacksonville agreement, which expired April 1, last, calling for $7.50 a day.

The new contract does not apply to mines in districts 21 and 25 that do not hold membership in the association. Fulfillment of the agreement is guaranteed by the international union, Mr. Johnson said.

The agreement also renews the rules and regulations that were effective from 1924 to 1927 and as amended in October, 1927. These regulations had expired on March 31, 1928.

On the ton basis the new contract calls for $1.01 a ton to $1.52 1/3 a ton, according to the thickness of the coal.

The southwestern association operates mines in Kansas, Missouri, Oklahoma and Arkansas.

James Skahan, president of district 14, United Mine Workers of America, declared the agreement would affect 6,000 miners in Kansas alone.

After announcing the result of the conferences, Skahan said he would issue a call for a meeting of representatives of the various unions of the district to meet in Pittsburg, Kans., for a referendum vote to determine if the miners are willing to accept the findings of the conferences.

While he was unwilling to predict the result of the referendum, he said that in previous instances miners had been willing to accept the decisions of their representatives.

Coal Stocks Still Fall

Coal stocks in consumers' hands declined about 1,000,000 tons in June, leaving slightly less than 40,000,000 tons of anthracite and bituminous coal in the United States and Canada as of July 1, states the National Association of Purchasing Agents. This was an average of 37 days for all industry. On July 1 the by-product coke industry averaged a 19-day supply of coal, the railroads 35 days, steel mills 41 days, and electric utilities and coke gas plants 67 days.

Colorado Company Signs $7 Scale With United Mine Workers

Coal miners employed by the Rocky Mountain Fuel Company, largest operator in the northern Colorado lignite field, will receive a wage increase of 23 cents a day under the terms of a contract agreed to August 18 by company officials and representatives of the United Mine Workers.

The increase will bring the basic wage in all mines operated by the company to $7 a day, as the present scale is $6.77 a day. The new contract becomes effective September 1 and will expire August 31, 1930.

The contract specifies that the wage scale can be reduced whenever producers of 51 percent of the coal in Boulder and Weld Counties reduce the scale below $6.77 a day, the prevailing wage scale in the district. However, it is provided that until operators, including the Rocky Mountain Fuel Company, mining 65 percent of the tonnage in the district, are operating under union control, the company agrees to pay the differential of 23 cents a day.

The Rocky Mountain Fuel Company was the only company in northern Colorado which accepted the union's invitation to negotiate a contract.

West Virginia Safety Meet

West Virginia's Third Annual Safety Meet, to be held at Bluefield, September 22, under the auspices of the West Virginia Department of Mines, promises to be the largest ever held. More than one hundred and fifty first-aid teams from every mining district in the State will compete for honors. It is expected that 40,000 people will attend, and an interesting program has been arranged. The National Coal Association will award one or more cups to the winning team. W. E. E. Koepler, secretary of the Pocahontas Operators' Association, Bluefield, is supervising director for the Safety Day Association, and anyone desiring detailed information should communicate directly with Mr. Koepler.

Pittsburgh Coal Co. Makes New Record

The Pittsburgh Coal Co. produced 220,309 tons of coal during the week ended August 25. This exceeded the July 28 high by 4,684 tons, which was the largest weekly production for any week since the company went on open-shop basis in May, 1925, and compares with 215,066 tons during the same week of last year. During the week ended August 25 there was an average of 8,520 men at work, compared with 8,015 in previous week and 6,327 men in corresponding week of 1927.

William J. O'Toole Killed in Fall

William J. O'Toole, president of the American Coal Cleaning Corporation, Welch, W. Va., died August 27, as the result of injuries received when he fell from a coal tipple at Gilliam, W. Va. At the time he was supervising the work of constructing new units of a preparation plant. Interment was in Bluefield.

Mr. O'Toole was the son of Col. Edward O'Toole, general superintendent of the United States Coal & Coke Co.

He was born in Monarch, Pa., March 25, 1894. He received an A. B. degree from Catholic University in Washington in 1915.

During the World War he served as a first lieutenant, attached to the 86th Division at Camp Grant, and subsequently was an instructor in the Officers' Training School, Camp Grant.

At the election of President Harding in 1920 he was appointed minister to Paraguay and entered the diplomatic service as the youngest minister of the United States Government. He served two years and eight months before he resigned to become sales manager of the Central Pocahontas Coal Co. at Welch.

He was a member of the American Institute of Mining and Metallurgical Engineers, the American Legion, and an honorary member of the American Society of the River Platte, Buenos Aires. He also belonged to the Union Golf and Tennis Association.

He was survived by his widow, four children, his father, and several brothers and sisters.

G. H. Caperton, Prominent West Virginia Operator, Taken By Death

G. H. Caperton, long prominently connected with the coal mining industry of West Virginia, former president of the Kanawha Coal Operators Association, present vice president of that organization, and at the head of several coal companies operating principally in the New River Field, died August 11 at his country home in Charleston from neuralgia of the heart, after a brief illness.

Mr. Caperton was born in Amherst County, Va., near Lynchburg, on September 13, 1860, and came to West Virginia in 1880. At the time of his death he was president of the New River Coal Company, the Slab Fork Coal Company, the Scotia Coal & Coke Company, the South Side Coal Company, was an officer or stockholder in other mining companies, as well as president of the New River Banking and Trust Company, and member of the Board of Directors of the Citizens National Bank and the Central Trust Company.

Surviving members of the family are, his wife, three sons, G. H. Caperton, Jr.,

William G. Caperton, Erskine M. Caperton, all of Charleston, and two daughters, Mrs. E. M. Blake, of New Haven, Conn., and Mrs. M. C. Banks, of Raleigh.

Mining Section of National Safety Council Has Interesting Program

The Mining Section of the National Safety Council will hold its annual session at the Waldorf-Astoria Hotel, New York City, October 2, 3, and 4. This group of meetings is a part of the large annual gathering of the National Safety Council. One session will be held the first day, two the second, and one the third day.

Both papers and open discussion will feature the meetings. Some of the papers are given below:

"Safety Pays," by Howard I. Young, vice president, American Zinc, Lead and Smelting Company, Mascot, Tenn.

"Methods and Results of Improved Foremanship Conferences," by H. A. Gilbertson, director of personnel, Lehigh Coal and Navigation Company, Lansford, Pa.

"Educating the Miner," by Cleveland E. Dodge, vice president, Phelps Dodge Copper Company, New York City.

"Safe Handling of Explosives Underground," by S. P. Howell, explosives engineer, U. S. Bureau of Mines, Pittsburgh, Pa.

"Safety, a Common Denominator in the Coal and Metal Industries," by D. D. Muir, vice president, United States Fuel Company, Salt Lake City.

"The Management Believes in Accident Prevention."

"Fires in Metal Mines—Causes, Prevention, and Methods of Handling."

Second National Fuels Meeting

The Second National Fuels Meeting under the auspices of the American Society of Mechanical Engineers is to be held at Cleveland September 17-20. The program is practically completed. At the first technical session papers will be presented on the constitution and classification of coal and fuel and their flame characteristics with reference to combustion values and furnace space requirement. At the second session the principal subjects considered will be Heat Transfer, Powdered Fuel, Relative Values of Solid, Liquid and Gaseous Fuels, etc. Wednesday will be occupied with sessions of Refractories and Stokers, Marine Practice, Station Methods, Pulverized Coal Firing, etc. The final day of the meeting will be devoted to Smoke Abatement. Numerous industrial plants at Cleveland and vicinity will be visited by the delegates.

National Coal Association Research Fellowship on Low-Temperature Tar

Kenneth M. Irey, of Monmouth, Ill., has been appointed to the National Coal Association Research Fellowship at the Carnegie Institute of Technology and the United States Bureau of Mines to determine the composition of tar produced in the low-temperature carbonization of eastern coals. The work will be along lines similar to those developed by preceding National Coal Association Fellowships, working on low-temperature tar from a western coal. It is a recognized fact that the success of low-temperature carbonization of any coal depends upon profitable disposal of the smokeless fuel and the by-products.

Union Rejects Daugherty, Ousted Ohio Subdistrict President

Efforts of miners in the Hocking Valley, Ohio, to secure reinstatement of Oral Daugherty, deposed subdistrict union president in that district, failed recently when the miners' petition was rejected at a session of the Ohio union's executive board.

The petition, declaring the only hope for the return to normal mining conditions in the Hocking Valley depends upon the reinstatement of Daugherty, was acted upon a short time after it was

—From Richmond (Va.) Times-Dispatch.

The Grass is Sweeter in Strange Pastures!

—Copyright, 1928, New York Tribune, Inc.

The Calm Before the Storm

formally presented to George W. Savage, secretary-treasurer of the Ohio union, by Harley Worden, supporter of Daugherty, and a number of the union's wage scale committee in the Hocking district.

The Ohio union executive board reaffirmed its action of several months ago deposing Daugherty as president of the Hocking subdistrict for failure to carry out the union's strike policies and interfering with the strike in his district. Daugherty had made a number of speeches criticizing the policy of the International Mine Union for continued adherence to a demand for the Jacksonville wage scale of $7.50 a day. He contended the operators could not possibly pay such a scale without suffering heavy losses themselves, and advocated "an immediate return to work to keep our miners from starving."

$4,000,000 of Kentucky Coal Properties Merged

The Utilities Elkhorn Coal Company, capitalized at $1,700,000, has been organized to consolidate coal properties in Knott, Pike and Floyd Counties, Ky., valued at $4,000,000 and including seven going operations and two undeveloped leases, all in the Elkhorn fields. The properties are mines 1, 2, 3, 4 and 5 of the Beaver Mining Company, the Rogers Elkhorn mine and the mine of the Furnace Coal Mining Company, Ashland. The merger was promoted by Ben F. Tate, president of the United Collieries, Inc., Cincinnati.

Maryland New River Company Acquires Nuttalburg Mine From Fordson Coal Company

The Maryland New River Coal Company, Philadelphia, Pa., has acquired from the Fordson Coal Company the Nuttalburg mine, plant and equipment located at Nuttal, Fayette County, W. Va., producing Sewell seam New River coal. The plant, which has a capacity of 2,500 tons daily, adjoins the Maryland New River Company's present operation at Wineona on the C. & O., and will be operated under the same management.

Illinois Production Shows Increase

The July report of the Illinois State Department of Mines and Minerals shows that Illinois produced 3,136,914 tons of coal in July, with a total of 122 mines operating. Of this amount 12 strip mines produced 278,578 tons. A total of 36,424 men were employed during the month. The average number of days worked was 14.7. In July, 1927, Illinois mines produced 340,624 tons. The total for the first seven months of 1928 is 28,710,158.

Pennsylvania Resources of Bituminous Coal

There are more than 44,000,000,000 tons of recoverable bituminous coal in Pennsylvania, according to a survey of soft coal resources just completed by the state geologist in 25 counties. Since the mining of bituminous coal was started 5,823,163,000 tons have been removed and nearly eight times that amount remain to be mined.

Greene County alone contains today more than enough bituminous coal unmined than has been taken from all the counties possessing bituminous mines. The survey places this amount at 6,276,-251,000 tons. So far more coal has been taken from the mines of Westmoreland County than any other, the total being 1,218,141,000, but there are still 3,297,-500,000 tons of recoverable coal in the county. The state geologist's office worked for a year and a half on its estimates after gathering the data. This work was started in 1921 and the data includes the year 1926. Its exact estimate of the unmined coal is given as 44,022,840,000 tons. In arriving at their estimates the experts did not consider seams of coal less than 18 inches thick.

The bituminous coal resources of the state are given by counties as follows:

County	Mined out and lost	Recoverable
Allegheny	969,200,000	1,498,948,000
Armstrong	107,290,000	2,491,100,000
Beaver	7,650,000	651,517,000
Blair	23,900,000	36,508,000
Bradford	14,500,000	15,514,000
Butler	39,300,000	2,257,511,000
Cambria	466,900,000	3,638,080,000
Cameron	235,000	33,561,000
Centre	75,250,000	275,076,000
Clarion	60,000,000	1,262,300,000
Clearfield	308,210,000	2,165,400,000
Clinton	17,221,000	54,580,000
Elk	54,775,000	300,473,000
Fayette	899,544,000	2,604,400,000
Greene	42,390,000	6,276,251,000
Indiana	299,200,000	4,288,700,000
Jefferson	279,400,000	2,123,400,000
Lawrence	16,445,000	484,020,000
Lycoming	7,000,000	40,000,000
Mercer	80,000,000	224,540,000
McKean	1,615,000	226,303,000
Somerset	187,384,000	3,986,900,000
Tioga	48,000,000	55,660,000
Washington	557,763,000	5,481,680,000
Westmoreland	1,218,141,000	3,297,500,000

Pennsylvania May Have Rock Dusting Law

A bill designed to make rock dusting compulsory to some extent in Pennsylvania bituminous mines has been prepared for introduction at the next session of the Pennsylvania Legislature. The measure was drawn up by officials of the State Department of Mines after they had conferred with Dan Harrington, chief safety engineer of the United States Bureau of Mines. The measure is understood to contain a requirement that operators furnish a supply of dust near every working face and that miners place the rock dust as the work advances.

Improvements At Alabama Mine

The Brookside-Pratt Mining Company, Birmingham, Ala., has leased the old "E" mine of the Tennessee Coal, Iron & Railroad Company, at Blossburg, and is making extensive improvements preparatory to resuming operations. The construction program includes a new tipple, washery and the installation of Deister tables for the preparation of the product. The plant will be completely electrified, motors being installed for inside haulage and other equipment provided to bring about an ultimate production of about 700 tons daily.

Washington Coal Rate Suspended

Increased coal rates which the Chesapeake and Ohio, Norfolk and Western, and Virginia railways proposed to apply on shipments from West Virginia into Washington, D. C., and adjacent points on August 10, were suspended August 3 by the Interstate Commerce Commission until March 10.

Investigation into the justice of the increase, which has been protested by Washington coal consumers and Government representatives, was ordered to be conducted during the suspension.

At present, rates from New River mines in West Virginia to Washington and from the Pocahontas district are $2.84 per ton while the suspended schedules would have made them $3.13. The West Virginia producers likewise protested the proposed increases.

Rockhill Anthracite Mines to Operate Despite Receivership

J. William Wetter, receiver for the Rockhill Coal & Iron Company, Philadelphia, has been authorized to borrow $50,000 on receiver's certificates for the purpose of keeping the anthracite mines of the company in operation. The mines are in Schuylkill County, Pa.

Gen. E. J. O'Toole on World Trip

Gen. Edward J. O'Toole, general superintendent of the United States Coal & Coke Company, Gary, W. Va., sailed August 11 for Australia on a trip around the world.

General O'Toole, who organized and heads the American Coal Cleaning Corporation, of Welch, W. Va., will visit the Fiji Islands, New Zealand, Australia, Japan, Shanghai, Hongkong, Singapore, Calcutta, Bombay, Port Said, Italy, Germany, France, Austria, Hungary, Poland, Belgium, Holland and England.

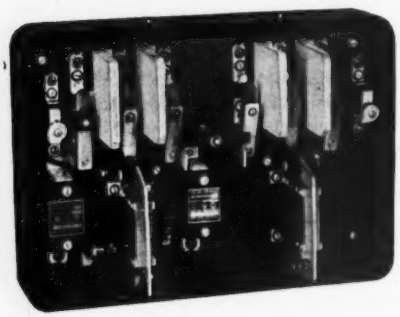
There are a number of plants installed in foreign countries, in which equipment manufactured by his company is used, and at present the company is manufacturing 22 dry-cleaning plants and 50 more under consideration.

WITH THE MANUFACTURERS

Across-the-Line Reversing Switch

The General Electric Co. announces a new motor control switch suitable for reversing small alternating-current motors in cases where the motor can be thrown across the line. It consists of two triple-pole, barrier-type, magnetically operated contactors, mechanically and electrically interlocked, and two hand-reset temperature overload relays mounted on a molded base and enclosed in a drawn-shell enclosing case.

The double-break contactors with silver contacts, operated by a high-speed solenoid, give the switch a very high



interrupting capacity with minimum arcing. The new type silver contacts eliminate the need for the shunt straps and, since silver oxide is a conductor, minimize contact resistance.

The two temperature overload relays protect the motor from overheating because of mechanical overload or single-phase operation. These relays are a fixed part of the switch, but have interchangeable heaters. To adapt this switch for use with a motor of a different rating but the same voltage, it is merely necessary to select heaters corresponding to the motor current.

The enclosing case, finished in black water-japan varnish, has rounded edges and corners which give it a neat appearance. The cover is held in place by two pins at the top and by a screw at the bottom. Additional clips can be supplied to permit the use of a padlock.

The new switch is expected to find a wide application on general-purpose motors when either infrequent or frequent reversing is required. Many applications, such as motor-operated doors and windows, valves and machine tools, require a reversing switch, a push button and either a geared-type or track-type limit switch. The size and appearance of the new switch are such that it can be readily mounted on any machine for use with any of these applications.

Designation CR-7009 B-12 has been assigned to the switch.

Link-Belt Issues New Crawler Crane Book

The new "Built for Service" Crawler Crane Book No. 995, just issued by Link-Belt Company, is one of the most attractive and complete of its kind ever published. It covers the complete Link-Belt line of gasoline, Diesel and electric crawler cranes of capacities up to and including the 2 cu. yd. heavy duty machine as well as standard locomotive cranes.

The book is generously illustrated to show the use of the dragline, dipper and trench shovels, skimmer scoop, hook block, pile driver, and other attachments which may be used without changing or disturbing the bodies of the machines.

Data on lifting capacities, approximate operating speeds, line pull, tractive effort, etc., is given. The tables in which this data is arranged have been supplemented by line drawings which show dimensions for operating limits.

An interesting feature of the book is the fact that illustrations and complete specifications of the new K-55, 2 cu. yd. capacity, heavy duty cranes are shown. This crane is the only one of its size which can be transported from job to job loaded on a flat car without dismantling.

The final portion of the book is devoted to illustrations of standard and long-radius locomotive cranes and other loading and unloading equipment.

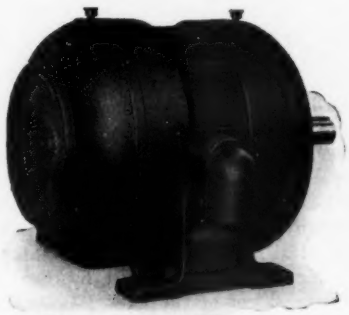
Copies of this book will be mailed upon request to Link-Belt Company, 300 West Pershing Road, Chicago.

Combustion Engineering Corporation, 200 Madison Avenue, New York City, announces the appointment of W. O. Renkin as manager of the Industrial Furnace Department.

Mr. Renkin is well known in the iron and steel industry, particularly as a pioneer in the application of pulverized fuel to metallurgical and industrial furnaces.

Totally Enclosed Fan Cooled Motors

A new line of totally enclosed, fan-cooled motors, 1 to 50 hp., has been developed by Allis-Chalmers Manufacturing Co. In this new design, all of the active parts, such as stator core, stator winding and the rotor, are completely enclosed, preventing contact of outside air, dirt, dust, fumes, moisture, etc., with the interior or active parts. Heat is carried away by a sufficient volume of cooling air forced around and across those parts which conduct the heat from the interior to the outer surfaces. A circumferential air jacket controls the



path of cooling air. Solid cast-iron bearing housings are attached to stator end heads with machined fit, which, with grease-packed bearings, form a perfect end closure. Internal parts of motor are readily accessible by removal of housings. A unique feature is that in many ratings this totally enclosed design delivers the same horsepower output as is obtained from the same frame in the standard open rating. Temperature rise is within 55° C. measured by the resistance method. The design provides for a most rugged construction with a minimum number of parts.

General Electric Company Supplementary Compensation

The General Electric Company paid $1,600,905 in supplementary compensation on July 30 to employes in its various plants and offices who have been in the employ of the company for five years or more. This sum, the largest ever distributed by the company in this form, represents 5 percent of the earnings of employes for the six months ending June 30, 1928. The largest amount, $499,425, was paid to employes of the Schenectady Works.

Brown-Fayro Company Acquires Austin Mine Pump

The Austin Mine Pump Department of Dravo-Doyle Company, Pittsburgh, has been sold to the Brown-Fayro Company, of Johnstown, Pa. Mr. E. F. Austin has resigned from Dravo-Doyle and becomes vice president of the Brown-Fayro Company, in charge of their Pittsburgh sales office and warehouse.

The Dravo-Doyle Company will continue to serve the mining industry with DeLaval pumps and speed reducers and Shepard electric cranes and hoists.

Dravo-Doyle Company, of Pittsburgh, now represent the C. H. Wheeler Mfg. Company, of Philadelphia, Pa., and are in a position to furnish any information on the following well-known products:

Condensers for power plant and water works service; jet condensers of low level and of barometric type; Rotrex and rotative vacuum pumps; heat exchangers of all types for both liquid and vapor, including the Leach Fracto heat exchanger; copper expansion joints; swing check valves; steam strainers.

Company Adopts Air Mail for Inter-Office Correspondence

For over a month Stephens-Adamson Mfg. Co., of Aurora, Ill., have been using air mail exclusively for every ounce of mail between the main office and the Pacific coast factory at Los Angeles.

Mr. C. H. Adamson, secretary of the firm, reports that he can now mail a letter Monday afternoon and depends on having his reply with required blue prints, data, etc., on his desk Friday morning. By regular, first-class mail he considered himself fortunate to receive his answer by the succeeding Tuesday or Wednesday.

The experiment was started before the recent reduction in air mail rates to 5 cents for the first ounce and 10 cents for each additional ounce, and even at the old high rates the saving in time was well worth the added cost.

Mr. Adamson says that in several cases his firm has been able to produce and ship an elevator or conveyor three or four days ahead of schedule and trace the saving in time directly to air mail.

The Illinois Central Railroad Company has purchased a 600 hp. oil-electric locomotive from the Ingersoll-Rand Company and the General Electric Company. It will be used in switching service in the city of Chicago.

The July issue of *The Explosives Service Bulletin*, published by E. I. du Pont de Nemours & Co., carries an article entitled "The Bench Method of Driving Large Mine Drifts and Tunnels."

New Sullivan Bulletins

Sullivan "L-8" Rotator Drill, described in Bulletin 81-T. The "L-8" is a 39-lb., one-man rotator drill for all-around rock-drilling service, in a range as wide as from shot holes in anthracite mining to general purpose drilling in quarries and on contract work. Simplicity, relative freedom from vibration, and consequent ease of handling are claimed as desirable features. The machine may be mounted on a cradle and shell for use on a mining column, or on a tripod for deeper down holes. It may be equipped with water tube and jet for work of this sort. A hollow piston and hole cleaning device are features of the machine as regularly supplied.

Sullivan "K-3" Concrete Breaker, described in Bulletin 81-U, 8 pages. The "K-3" is a powerful and substantial compressed air tool for concrete breaking of the heaviest and most difficult kinds. It weighs 84 lbs. and employs a cylindrical hollow valve for imparting the impulses of air to the piston.

Grant Thorn recently resigned as sales manager of the American Cyanamid Company to become associated with the subsidiaries of International Combustion Engineering Corporation, New York, which are identified with the coal-tar products and allied chemical fields.

Research Engineer Wins Dudley Honor Prize

Alfred V. de Forest, research engineer for the American Chain Company, was recently honored by the National Society for Testing Materials, which organization awarded him the Dudley National Medal in recognition of his achievement in perfecting the nondestructive test for materials. With the device Mr. de Forest has developed it is now practical for anyone to sit in front of a machine and by means of a graph, on which appears a hysteresis loop, determine instantly whether or not the material passing in front has the slightest defect.

It is said that this invention will have a far-reaching effect on the quality of all materials used in industrial machinery.

Mr. de Forest has been chief research engineer for the American Chain Company since 1918, his activities extending to the products of all the American Chain associate companies, such as the American Cable Company, Page Steel & Wire Company, Manley Equipment Company, Reading Steel Casting Company, Dominion Chain Company, and others.

New Prest-O-Lite Plants

The Prest-O-Lite Co., Inc., has lately added two new plants to its nation-wide chain, making the total 33. These will serve near-by industry with dissolved acetylene, used in oxy-acetylene welding and cutting. A plant in charge of H. A. Smith, at 631 South Seventeenth Street, Harrisburg, Pa., started production on July 12, and another, at Seventeenth and West Lawrence Streets, Allentown, Pa., J. W. Summers, superintendent, commenced operations on July 21.

Linde Opens New Plants

Four new Linde plants have recently started production of oxygen and are now serving the local demand in their respective localities. On July 3 a plant at Harrisburg, Pa., started operating in charge of J. J. Naber. A plant at Seventeenth and West Lawrence Streets, Allentown, Pa., in charge of W. Barber, began production on July 18. On August 1 the Shreveport, La., plant, located at Foster and Thomas Streets, in charge of F. T. Rueger, started operating. Last of all, a plant at First Avenue and B Street, South Charleston, W. Va., was added to the chain. Ed Pohlman is superintendent at the latter plant, which started manufacturing August 10. The opening of these plants brings the total up to 52 Linde oxygen-producing plants throughout the country.

"Getting Facts About Accidents" is the second of a series of publications issued by the Policyholders' Service Bureau of the Metropolitan Life Insurance Company, presenting the basic principles of successful industrial safety work.

This booklet, addressed primarily to the chief operating official, outlines current industrial practice in obtaining and using accident facts as a means of promoting plant safety. Accident forms are provided, which have been found helpful in recording the necessary facts and making them available for study. There is also given a description of methods by which this information may be put to maximum preventive use.

"Perhaps, more than anyone else, the foreman can control labor turnover," according to the third booklet in the Labor Turnover Series just issued by the Policyholders' Service Bureau.

"The Foreman and Labor Turnover" contains a composite of the views of 40 manufacturing concerns on the position of the foreman. The study, in common with all other surveys made by the Policyholders' Service Bureau, was prepared at the request and for the benefit of group insurance policyholders.

Copies of these booklets may be obtained by those interested in the subject by addressing the Policyholders' Service Bureau of the Metropolitan Life Insurance Company, New York City.

AMERICAN STANDARDS ASSOCIATION TO SUCCEED AMERICAN ENGINEERING STANDARDS COMMITTEE

Reconstruction of the American Engineering Standards Committee to keep pace with the growth of the industrial standardization movement in the United States is now under way, according to an announcement by the committee. The principal features of the reconstruction are the definite federation of national organizations, under the name American Standards Association, in such a way that trade associations interested in standardization may more readily join in the direction of the movement; placing the technical work of approving standards in a standards council; and concentrating administrative and financial responsibility in a board of directors composed of 12 industrial executives.

The reorganization has been unanimously approved by the main committee of the A. E. S. C., and is now being voted upon by the member bodies. The action of the committee results from more than a year's intensive consideration of the subject by the main committee and rules committee. The latter was enlarged for the purpose to include a representative of each of the 19 member bodies desiring representation.

In submitting the plan for the formal approval of the member bodies William J. Serrill, chairman of the committee, states:

"The 10 years' experience of the committee has brought to light certain fundamental difficulties inherent in the old organization. It is the purpose of the reorganization to eliminate these difficulties, to place the operation of the committee on a sound administrative basis, and to facilitate the financing of the work on an adequate scale."

Among the conditions which led to the reorganization are the growth of the trade association movement, together with the predominating position which the trade association is coming to have in the field of industrial standardization, and the increasingly important direct part which the plant executive is playing in the standardization activities within his plant and in the movement as a whole. Recognition of this latter condition is reflected in the make-up of the board of directors, which will control the general administrative and financial affairs of the association. The industrial executives composing this board will be elected on nomination of member bodies and will serve for three years.

Approval of standards and matters of procedure will be in the hands of a standards council. The council will be composed of not more than three representatives of each of the member bodies, the councillors also serving for a period of three years.

"The underlying principles of the A. E. S. C. remain unchanged," Mr. Serrill adds. "The basic functions remain completely in the hands of the representatives of the member bodies. The individual members, whether of the board of directors or of the standards council, are appointed or nominated by the member bodies, which thus remain the fundamental units in the organization.

"The name American Standards Association is being adopted as more accurately descriptive of the reorganized association, and also because of the misunderstandings and misconceptions which have frequently occurred in connection with the words 'engineering' and 'committee.' The scope of the work is, however, being limited to those fields in which engineering methods apply."

PERMISSIBLE EQUIPMENT

A complete list of permissible mining equipment, rescue apparatus and gas masks tested and approved by the Bureau of Mines, up to and including July 1, 1928, has been published. It covers electric air compressors, coal drills, mining machines, loading machines, conveyors, mine pumps, room hoists, mine telephones, rock-dusting machines, switches, electric cap lamps, flame safety lamps, electric hand and trip lamps, flash lamps, methane indicators and detectors, blasting units, storage battery locomotives, tandem locomotives, power trucks, concrete mixers, self-contained oxygen breathing apparatus and gas masks.

FLOTATION OF LOW-GRADE PHOSPHATE ORES

The study of the flotation of low-grade phosphate ores, now under way at the Southern Experiment Station of the Bureau of Mines, indicates that flotation has possibilities not only for ground material but also for unground sands minus 20-mesh in size. Though concordant results have not been obtained in all tests, the separations obtained are believed to be indicative. In several tests on unground sands recoveries of from 90 to 95 percent of the phosphate have been obtained with concentrates that are of commercial grade or can be made so by a single cleaning treatment. Reagent consumption has been decreased somewhat from the amounts required in the early work. No reagent combinations other than those based on oleic acid, sodium oleate, or soaps containing considerable amounts of sodium oleate have been found that effect a separation between the phosphate and quartz.

PULVERIZED-COAL BURNING MACHINERY INSTALLED ON READING RAILROAD COMPANY TUG

Installation of coal-pulverizing machinery has been started aboard the *Tamaqua*, an ocean-going tug owned by the Reading Railroad Company. The machinery, costing approximately $25,000, is scheduled to be in operation shortly and the vessel placed in the Philadelphia and New England ports' service.

This will be the first tug to utilize pulverized coal as a fuel. No auxiliary systems of supplying other types of fuel are to be installed, but full dependence for obtaining propulsion power will be placed upon the new system. The method of pulverizing the coal, it is understood, is by the impact method, and after passing through a series of fans acting in the capacity of pulverizers, the powdered coal is then conducted through pipes to the boilers where air is mixed with the pulverized fuel and burned.

A fuel saving from 13 to 20 percent is expected from the new system, said George McQuilkin, chief engineer of the Reading Company in charge of the installation.

NEW EDUCATIONAL FILM DEPICTS HAZARDS OF CARBON MONOXIDE

As a means of reducing the heavy annual death rate caused by that insidious and almost universal poison gas, carbon monoxide, the Bureau of Mines has completed a one-reel educational motion-picture film entitled "Carbon Monoxide: The Unseen Danger." This film, prepared in cooperation with one of the large automobile manufacturing companies, shows vividly how this deadly gas may be encountered in workshop, garage and home, points out ways of preventing accumulations of the gas, and visualizes methods of reviving victims of the gas.

This educational motion-picture film is now available for showing by schools, churches, clubs, civic and business organizations, miners' local unions and other bodies. Copies may be obtained from the Pittsburgh Experiment Station of the United States Bureau of Mines, Pittsburgh, Pa. No charge is made for the use of the film, but the exhibitor is requested to pay transportation charges.

TO RECOVER CULM BANKS

The Lehigh Valley Coal Company has awarded a contract to the Central Pennsylvania Quarrying & Stripping Company to load the culm banks between Delano and Mahanoy City, Pa. The culm will be prepared in the Lehigh breakers for small size fuel.

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Prest-O-Lite Co., Inc., 30 E. 42d St., New York City.

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ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

ACID, SULPHURIC
Irvington Smelting & Refining Works, Irvington, N. J.

AERIAL TRAMWAYS
American Steel & Wire Co., Chicago and New York.

AFTERCOOLERS (Air)
Ingersoll-Rand Co., New York City.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

AIR COMPRESSOR OILS
Standard Oil Co. (Ind.), Chicago, Ill.

AIR FILTERS—Bag type
American Coal Cleaning Corpn., Welch, W. Va.

AIR HEATERS
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

AIR LIFT PUMPING
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

ANNUNCIATOR WIRES & CABLES
John A. Roebling's Sons Co., Trenton, N. J.

ANNUNCIATOR WIRES & CABLES, INSULATED
American Steel & Wire Co., Chicago, Ill., and New York.

ANTI-RUST OILS & GREASES
Standard Oil Co. (Ind.), Chicago, Ill.

ARMATURE COILS & LEADS
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ARMORGRIDS
Hendrick Mfg. Co., Carbondale, Pa.
General Electric Co., Schenectady, N. Y.

ASPIRATORS
American Coal Cleaning Corpn., Welch, W. Va.

AUTOMATIC CAR & CAGER STOPS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.

AUTOMATIC CAR CAGES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

AUTOMATIC CAR DUMPERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

AUTOMATIC FLAGGING SIGNALS
American Mine Door Co., Canton, Ohio.

AUTOMATIC (Mine Doors, Trucks and Electric Switches)
American Mine Door Co., Canton, Ohio.

AUTOMATIC MINE SWITCHES
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

AUTOMATIC SWITCH THROWERS
American Mine Door Co., Canton, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

AUTOMOBILE CABLES
John A. Roebling's Sons Co., Trenton, N. J.

BAG TYPE AIR FILTERS
American Coal Cleaning Corpn., Welch, W. Va.

BALLAST UNLOADER ROPES
John A. Roebling's Sons Co., Trenton, N. J.

BALL BEARINGS
S K F Industries, 40 E. 34th St., New York City.

BALL & ROLLER BEARINGS
S K F Industries, 40 E. 34th St., New York City.

BARS, STEEL
Carnegie Steel Co., Pittsburgh, Pa.
Timken Roller Bearing Co., Canton, Ohio.

BATTERIES, Armature
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BATTERIES, Blasting
Hercules Powder Co., Wilmington, Del.

BATTERIES, DRY (for Bells, Buzzers, Signals, Blasting)
National Carbon Co., Inc., 30 East 42nd St., New York City.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O-Lite Co., 30 East 42d St., New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BEARINGS
S K F Industries, 40 E. 34th St., New York City.

BEARINGS (for all kinds of equipment)
Hyatt Roller Bearing Co., Newark, N. J.

BEARINGS, ANGULAR CONTACT
S K F Industries, New York City.

BEARINGS, ANTI-FRICTION
S K F Industries, New York City.

BEARINGS, ARMATURE
S K F Industries, New York City.

BEARINGS, AUTOMATIC
S K F Industries, New York City.

BEARINGS, BALL
S K F Industries, New York City.

BEARINGS, JOURNAL, CAR & LOCOMOTIVE
S K F Industries, New York City.

BEARINGS, MOTOR, ELECTRIC
S K F Industries, New York City.

BEARINGS RADIAL
Timken Roller Bearing Co., Canton, Ohio.
S K F Industries, New York City.

BEARINGS, ROLLER
S K F Industries, New York City.

BEARINGS, SHAFT, SELF-OILING
S K F Industries, New York City.

BEARINGS, TAPERED ROLLER
Timken Roller Bearing Co., Canton, Ohio.

BEARINGS, THRUST
S K F Industries, New York City.
Timken Roller Bearing Co., Canton, Ohio.

BELL CORD
John A. Roebling's Sons Co., Trenton, N. J.

BELT DRESSING
Standard Oil Co. (Ind.), Chicago, Ill.

BELTING (Conveyor, Elevator, Transmission)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BELTING, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

BINS (Coke and Coal)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BITS, Carbon (Diamonds) for Core Drill
R. S. Patrick, Sellwood Building, Duluth, Minn.
Diamond Drill Carbon Co., World Bldg., New York.

BITS, Diamond Drilling
R. S. Patrick, Sellwood Building, Duluth, Minn.

BIT SHARPENERS
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

BLACK DIAMONDS
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

BLACK OILS
Standard Oil Co. (Ind.), Chicago, Ill.

BLASTING CAPS
Hercules Powder Co., Wilmington, Del.

BLASTING MACHINES
Hercules Powder Co., Wilmington, Del.

BLASTING POWDER
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING SUPPLIES
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING UNITS (Dry Battery)
National Carbon Co., Inc., 30 East 42nd St., New York City.

BLOCKS, PILLOW
S K F Industries, New York City.

BLOWERS, CENTRIFUGAL
American Coal Cleaning Corpn., Welch, W. Va.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BLOWERS (or Compressors)
General Electric Co., Schenectady, N. Y.

BLOWERS (Tubing)
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Robinson Ventilating Co., Zelienople, Pa.

BLOWERS (Turbine)
Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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Oxweld Acetylene Co., 30 E. 42d St., New York City.

BLUE CENTER STEEL WIRE ROPE
John A. Roebling's Sons Co., Trenton, N. J.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

BOND TERMINALS
American Mine Door Co., Canton, Ohio.

BORTZ
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Diamond Drill Carbon Co., World Bldg., New York.

BRACES, GAUGE
Central Frog & Switch Co., Cincinnati, Ohio.

BRACES, RAIL
Central Frog & Switch Co., Cincinnati, Ohio.

BRACES, TRACK
Central Frog & Switch Co., Cincinnati, Ohio.

BRAZILIAN ROCK CRYSTAL
Diamond Drill Carbon Co., World Bldg., New York.

BREAKER MACHINERY
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

BREAKERS
American Coal Cleaning Corpn., Welch, W. Va.

BREAKERS (Construction and Machinery)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BREAST MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

BRIQUETTING MACHINERY
Vulcan Iron Works, Wilkes-Barre, Pa.

BRUSHES (Carbon, Graphite and Metal Graphite for Electric Motors, Generators and Converters)
National Carbon Co., Inc., Cleveland, Ohio, and San Francisco, Calif.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

BUCKETS (Elevator)
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CABLE COMPOUNDS
Standard Oil Co. (Ind.), Chicago, Ill.

CABLE GREASE
Keystone Lubricating Co., Philadelphia, Pa.

CABLES
American Steel & Wire Co., Chicago and New York.
Roebling's Sons Co., John A., Trenton, N. J.
Ohio.

CABLES (Connectors and Guides)
American Mine Door Co., Canton,

CABLES, INSULATED
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.

CABLES, SUSPENSION BRIDGE
John A. Roebling's Sons Co., Trenton, N. J.

CABLEWAYS
American Steel & Wire Co., Chicago, Ill., and New York.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CAGE DUMPERS, ROTARY
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

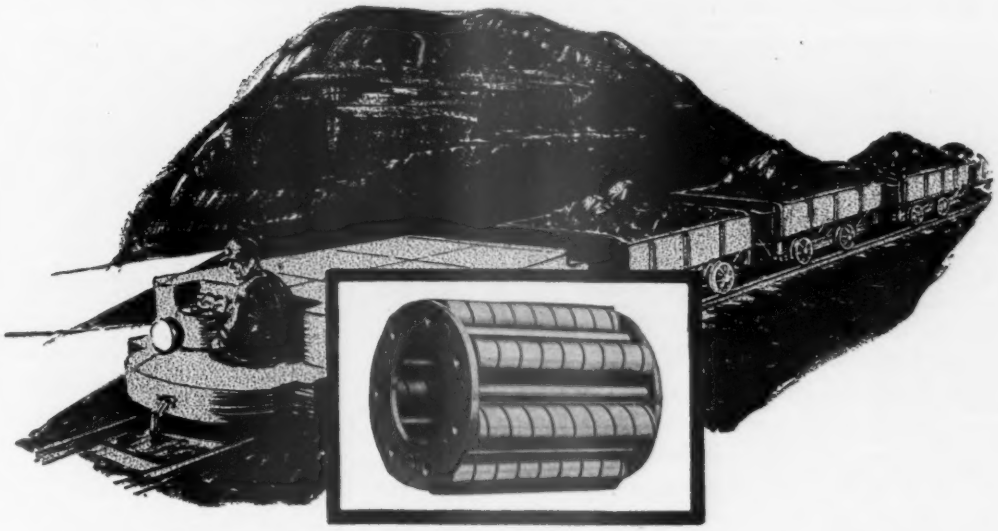
CAGES (Safety Appliances)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

CAGE STOPS & LOCKS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

CAGERS, AUTOMATIC
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

CAGERS, AUTOMATIC & MANUAL
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

CAGES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.



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CARBON FOR DIAMOND DRILLING
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Roberts & Schaefer Co., Chicago, Ill.

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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

CAR FEEDERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

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O. Barlow Willmarth, Georgetown, Colo.

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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CAR RETARDERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

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Hockensmith Wheel & Mine Car Co., Penn, Pa.

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Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

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John A. Roebling's Sons Co., Trenton, N. J.

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Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Timken Roller Bearing Co., Canton, Ohio.

CASTINGS, GRAY IRON
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CASTINGS, OPEN HEARTH STEEL
Vulcan Iron Works, Wilkes-Barre, Pa.

CASTINGS (steel, iron)
Vulcan Iron Works, Wilkes-Barre, Pa.

CAST STEEL FROGS
Central Frog & Switch Co., Cincinnati, Ohio.

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Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, COAL CUTTING
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

CHAINS, DRIVE
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, FRONT END
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAIN LUBRICANTS
Standard Oil Co. (Ind.), Chicago, Ill.

CHAINS, OILING
Morse Chain Co., Ithaca, N. Y.

CHAINS, POWER TRANSMISSION
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, Silent (Bushed-Pin Joint)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAINS, SILENT (Rocker-Joint)
Morse Chain Co., Ithaca, N. Y.

CHAINS, SLING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SPROCKET WHEEL
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CIRCUIT-BREAKERS
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS, GUARD RAIL
Central Frog & Switch Co., Cincinnati, Ohio.

CLAMPS (Mine)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS, WIRE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CLIPS, WIRE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CLOTH, WIRE
Ludlow Saylor Wire Co., St. Louis, Mo.

CLUTCHES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CLEANING MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
American Rheolaveur Corporation, Wilkes-Barre, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

COAL COMPANIES
Lehigh Coal & Navigation Co., Philadelphia, Pa.
Thorne, Neale & Co., Philadelphia, Pa.

COAL CONVEYING MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CRUSHERS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CRUSHERS & ROLLS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

COAL CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL HANDLING MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

COAL LOADERS
Conveyor Sales Co., 299 Broadway New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

COAL MINING MACHINERY
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd Chicago, Ill.
Sullivan Machinery Co., 122 S Mich. Ave., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

COAL MINING PLANTS
American Coal Cleaning Corpn. Welch, W. Va.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

COAL PREPARATION MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

COAL SEPARATING MACHINERY
W. S. Tyler Co., Cleveland, Ohio.

COAL SEPARATORS (Pneumatic)
American Coal Cleaning Corpn., Welch, W. Va.
Roberts & Schaefer Co., Chicago, Ill.

COAL SEPARATORS (Spiralizers)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL TESTING EQUIPMENT
W. S. Tyler Co., Cleveland, Ohio.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

CONCENTRATORS (Table)
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CONCRETE REINFORCEMENT
American Steel & Wire Co., Chicago, Ill., and New York.

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Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONTROLLERS
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Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONVERTERS, COPPER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONVEYORS
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CONVEYOR BEARINGS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, BELT
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, CHAIN FLIGHT
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, COAL
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

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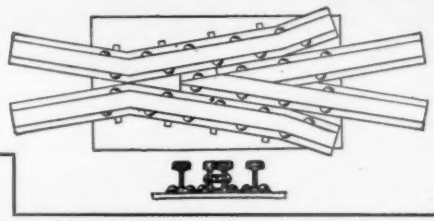
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.



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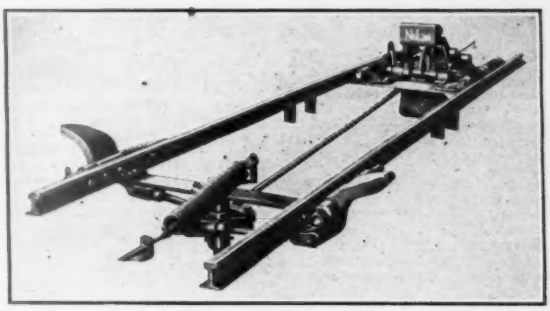

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Bowerston, Ohio

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The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, SCREW
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COOLERS, Man
Robinson Ventilating Co., Zelienople, Pa.

COOLERS, ROTARY
Vulcan Iron Works, Wilkes-Barre, Pa.

COPPER WIRE & STRAND (Bare)
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CORE DRILLS, Carbon (Diamonds) for
R. S. Patrick, Sellwood Building, Duluth, Minn.

CORE DRILLING
Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Pennsylvania Drilling Co., Pittsburgh, Pa.

COUPLINGS, FLEXIBLE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CROSSINGS AND CROSSOVERS
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West Virginia Rail Co., Huntington, W. Va.

CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.

CRUSHER OILS
Standard Oil Co. (Ind.), Chicago, Ill.

CRUSHERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Symons Bros. Co., Chicago, Ill.

CRUSHERS, Coal
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CRUSHERS, SINGLE & DOUBLE ROLL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHING PLANTS, COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRYSTAL (Quartz)
Diamond Drill Carbon Co., World Bldg., New York.

CUP GREASE
Keystone Lubricating Co., Philadelphia, Pa.
Standard Oil Co. (Ind.), Chicago, Ill.

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co., 30 E. 42d St., New York City.

CYCLONE DUST COLLECTORS
American Coal Cleaning Corpn., Welch, W. Va.

DECARBONIZING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

DESIGNERS OF PLANTS
American Coal Cleaning Corpn., Welch, W. Va.
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

DETONATORS
Hercules Powder Co., Wilmington, Del.

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Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DIAMOND DRILLING CARBON
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, BLACK (See Carbon and Bortz)
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, INDUSTRIAL
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

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DOORS, AUTOMATIC MINE
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Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

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Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

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R. S. Patrick, Sellwood Building, Duluth, Minn.

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Keystone Churn Drill Co., Beaver Falls, Pa.

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R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILL, CARBON (Diamonds) for
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R. S. Patrick, Sellwood Building, Duluth, Minn.

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Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

DRILL LUBRICANTS
Standard Oil Co. (Ind.), Chicago, Ill.

DRILLER'S DIAMONDS
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DRILLS, CORE
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The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

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Morse Chain Co., Ithaca, N. Y.

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Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

DRYERS, ROTARY
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Phillips Mine & Mill Supply Co.,
Roberts & Schaefer Co., Chicago, Ill. Pittsburgh, Pa.

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DUST FILTERS
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General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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Allis-Chalmers Mfg. Co., Milwaukee, Wis.

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Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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Ohio Brass Co., Mansfield, Ohio.
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Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.

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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

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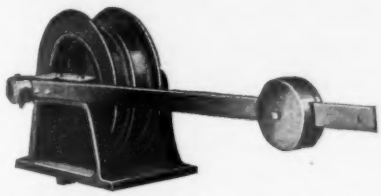

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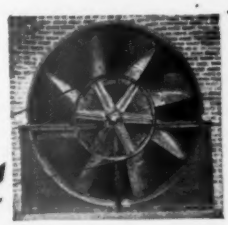

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Speed	432 R.P.M.	Speed	432 R.P.M.
Volume Delivered	61,000 cu. ft.	Volume Delivered	92,000 cu. ft.
Water Gauge	1 in.	Water Gauge	2.3 in.
Motor	45 H.P.	Motor	60 H.P.

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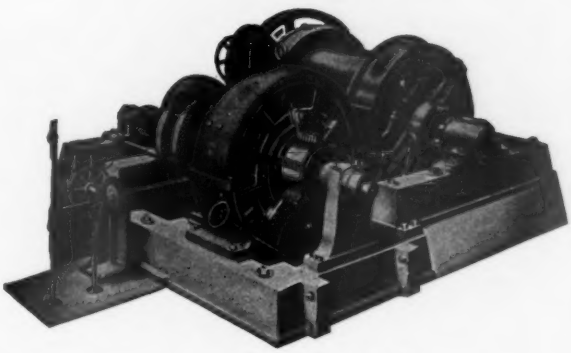

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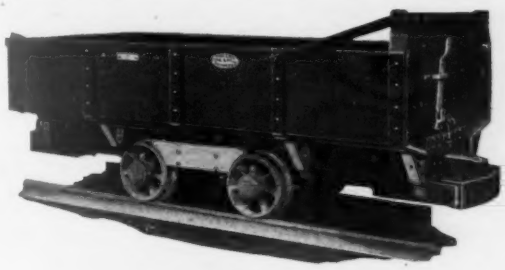

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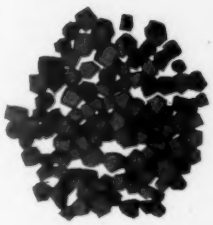

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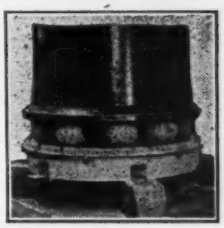

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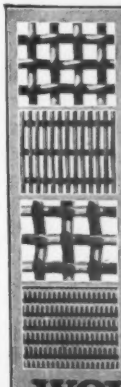

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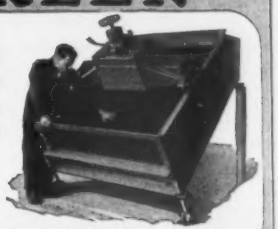

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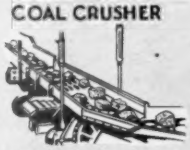
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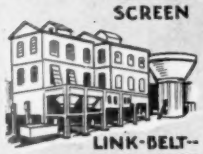
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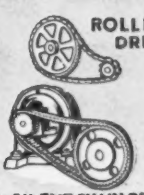
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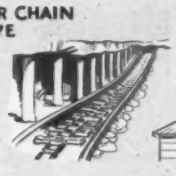

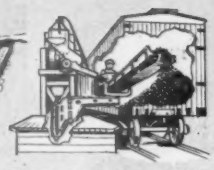

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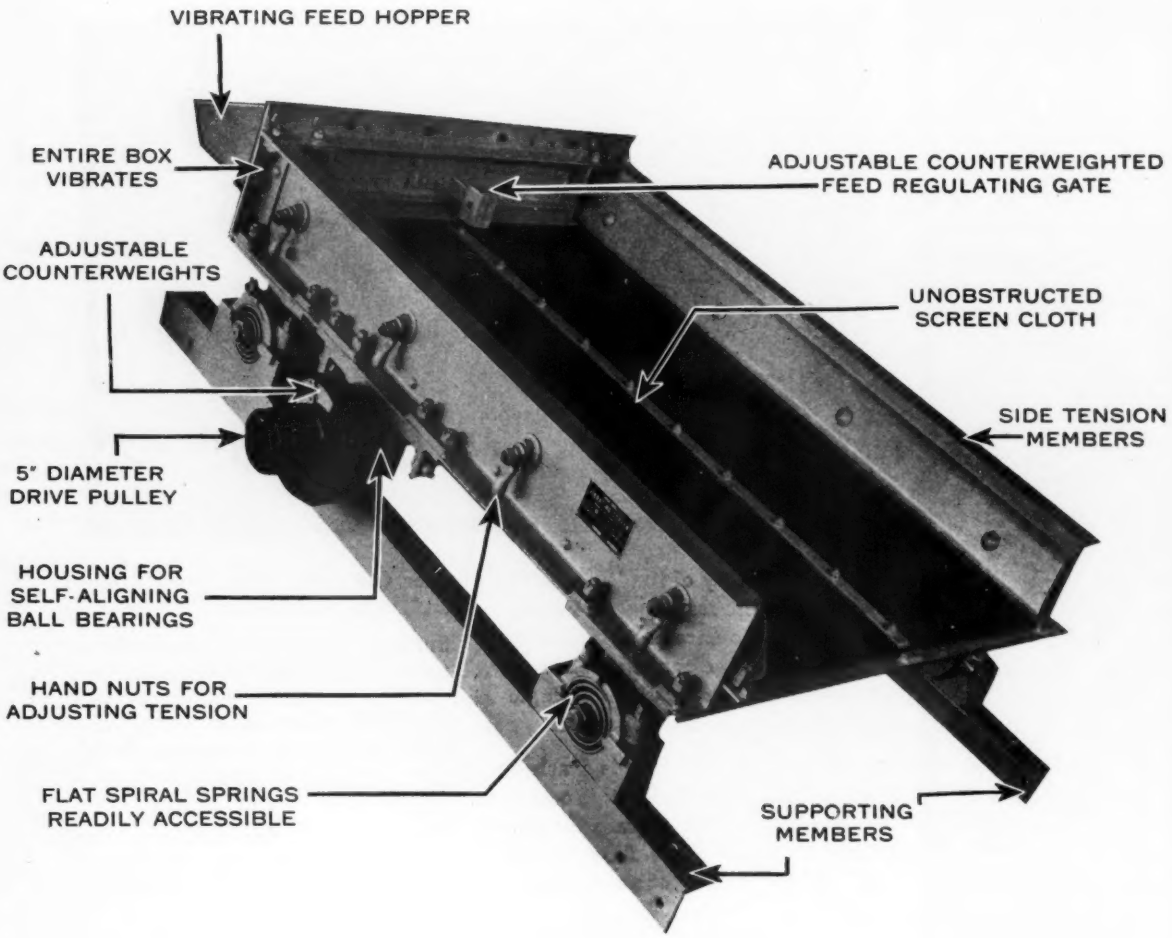

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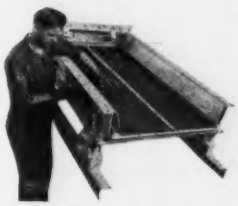
5. Minimum upkeep expense. Minimum power required.
6. Screen cloth is quickly and easily replaceable. Standard widths of wire cloth are used, and can be purchased in rolls from cloth manufacturers direct, at reduced prices.
7. No obstructions or dead areas on surface of screen cloth to cause material to build up and blind.
8. Peculiar throwing reactions of the flat spiral springs upon which screen box is mounted, quickly stratify the particles,—resulting in better screening efficiency.
9. Ability to handle screens as long as 8 feet, with attendant advantages of more accurate separations and larger capacities.
10. Vibrating receiving hopper distributes the feed, absorbs the wear of the discharge of material onto the screen, starts a partial stratification of particles, and adds to the effective screening length.
11. Purchaser receives the benefit of Link-Belt Service and Experience.

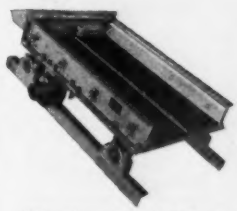
It is an interesting process; and the means for securing the results warrants a careful reading of Book No. 862, sent upon request to our nearest office.

Link-Belt vibrating screen, showing method of inserting screen cloth.

Link-Belt vibrating screen, showing method of applying clamp plates.



Link-Belt vibrating screen, showing method of adjusting tension in screen cloth.



Side view of Link-Belt vibrating screen. Notice especially the feed hopper; the counterweighted vibrator pulley; and the type of shock-absorbing flat spiral springs on which the four corners of screen box are mounted.

3285

LINK-BELT COMPANY

Leading Manufacturers of Elevating, Conveying, and Power Transmission Chains and Machinery

CHICAGO, 300 W. Pershing Road **INDIANAPOLIS, 200 S. Belmont Ave.** **PHILADELPHIA, 2045 W. Hunting Park Ave.**

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Buffalo - - - - - - - -554 Ellicott Square
Cleveland - - - - - 527 Rockefeller Bldg.
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Denver - - - - - - - - 520 Boston Bldg.
Detroit - - - - - - - 5938 Lindsdale Ave.
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H. W. CALDWELL & SON CO.:—Chicago, 2410 West 18th St.; New York, 2676 Woolworth Bldg.

LINK-BELT MEESE & GOTTFRIED CO.:—San Francisco, 19th and Harrison Sts.; Los Angeles, 361-369 S. Anderson St.; Seattle, 820 First Ave., S. Portland, Ore., 67 Front St.; Oakland, Calif., 526 Third St.

In Canada—LINK-BELT LIMITED—Toronto; Montreal; Elmira, Ont.

LINK-BELT

PERFECTED VIBRATING SCREEN

For Dumping Coal and Ore— Link-Belt Rotary Mine Car Dumper

Rotary Dumps minimize wear and tear on the structure, and lower repair expense on the mine cars. Solid box type cars, which cost less to buy and maintain, are practical for use in this type of dump.

Take advantage of our experience in making the right selection of a dump. We furnish all types and sizes.

3514.

LINK-BELT COMPANY

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LINK-BELT

Rotary Mine Car Dumper

ROTARY CAR DUMPER

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CAR HAUL

COAL CRUSHER

SHAKER SCREEN

VIBRATING SCREEN

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LOADING BOOM

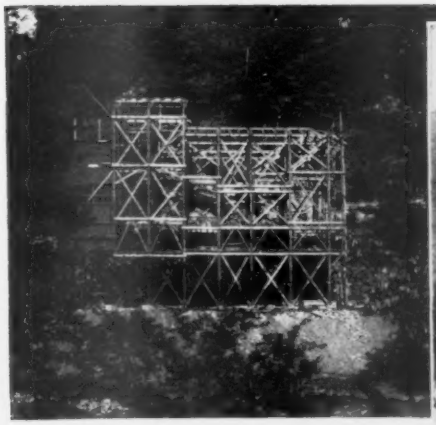
PICKING TABLE

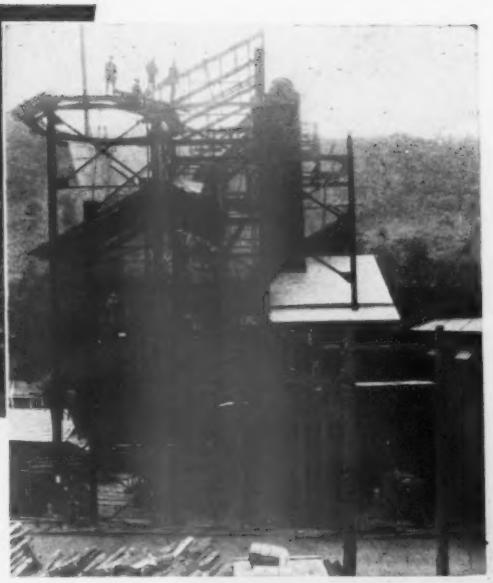
LOCOMOTIVE AND CRAWLER CRANE

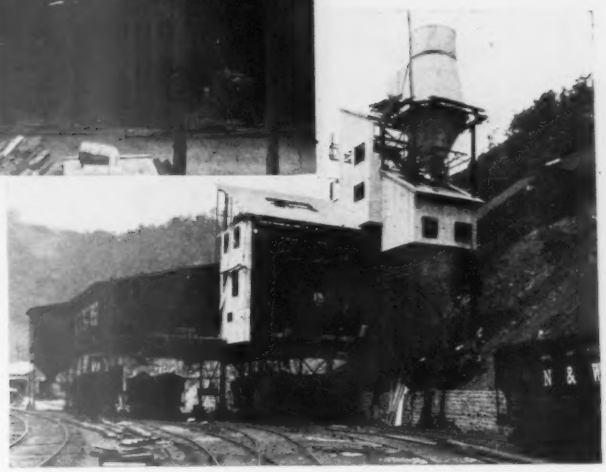
KANGAROO KONVEYOR

ROLLER CHAIN DRIVE

SILENT CHAIN DRIVE · CHAIN CONVEYOR · BOX CAR LOADER · BELT CONVEYOR · COMPLETE TIPPLE







From ground to tipple top

Plants Shown Above Are:

Gilliam Coal & Coke Co., Gilliam, W. Va. Capacity, 165 tons per hour, treating 2¾" to 0".

Arlington Coal & Coke Co., McDowell, W. Va. Capacity. 165 tons per hour, treating 2¾" to 0".

New River & Pocahontas Consolidated Coal Co., Newhall, W. Va. Capacity, 225 tons per hour, treating 2¾" to 0"

THREE of the Twenty-Two Pneumatic Separating Plants we have under construction which are nearing completion.

We are fully equipped and prepared to design and erect the complete tipple or breaker structure, furnish and install all necessary auxiliary equipment, and put into successful operation an AMERICAN Pneumatic Separating Plant of any size, FROM GROUND TO TIPPLE TOP.

Investigate the AMERICAN Pneumatic Process before investing in any coal cleaning equipment.

(See pages 172-181 inclusive—Keystone Coal Mining Catalogue, 1927 Edition)

AMERICAN

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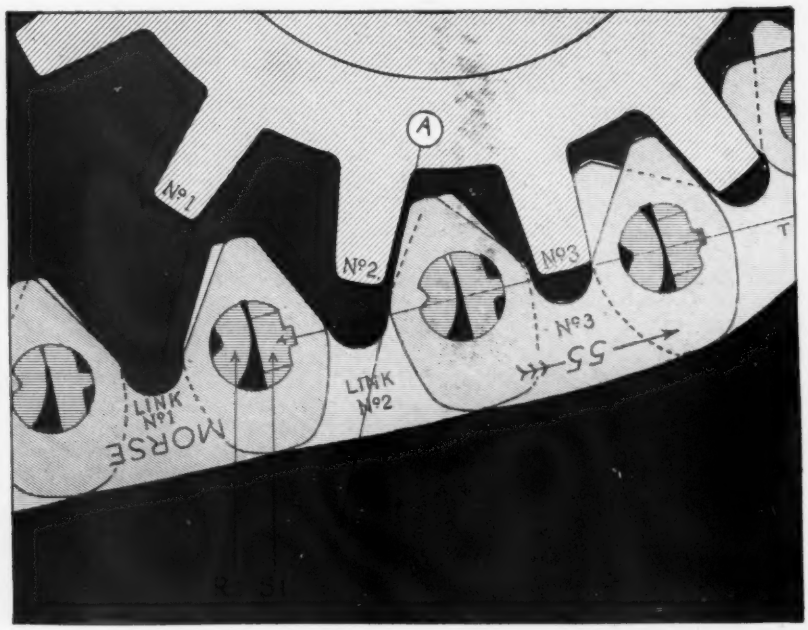
COAL CLEANING CORPORATION

WELCH, W. VA.

The MORSE Rocker Joint---
less wear---longer life---higher efficiency



The joint is the vital part of any silent chain and on its operation depend the efficiency and durability of the chain. Minimum joint wear, therefore, means long chain life.

The efficient rocker or rolling action of the Morse Rocker Joint eliminates the rubbing or sliding friction commonly found in all round pin chains. Referring to the illustration above, link No. 1 is pulling on its flat faced seat pin, S1, against rocker pin R2 in link No. 2.

Note how the original Morse Rocker Joint Chain carries the load between sprockets on a broad, flat bearing surface between pins, thereby reducing wear and preventing slippage. It rocks on a line contact only when the chain is entering and leaving the sprocket.

As the sprocket rotates, link No. 2 rolls around and reaches position of link No. 3. Note that the rocker pin has now rolled on the flat seat pin.

This Rocker Joint action combines with good material and expert workmanship, to make the Morse Silent Chain, noted for its 98.6% sustained efficiency and long life.

Let a Morse Transmission Engineer show you how Morse Drives are serving practically every power transmission need.

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MORSE SILENT CHAIN DRIVES

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